

**SALT LAKE CITY CORPORATION**  
**THE DEPARTMENT OF PUBLIC UTILITIES**

PROJECT MANUAL FOR CONSTRUCTION OF  
**MP3.16 – NORTH BENCH PUMP  
STATION**

**PROJECT NO. 513416337**

**FISCAL YEAR 2024-2025**



**Public**  
**Utilities**

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Mayor

City Council

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SALT LAKE CITY CORPORATION  
Salt Lake City, Utah

**PROJECT MANUAL  
(VOLUME 1)**

FOR

**MP3.16 – NORTH BENCH PUMP STATION**

**PROJECT NO. 513416337**

*PREPARED FOR*

DEPARTMENT OF PUBLIC UTILITIES  
ENGINEERING DIVISION  
1805 W. 500 S.  
SALT LAKE CITY, UTAH 84104

*PREPARED BY*

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Project Engineer: **Delmas W. Johnson, P.E.**  
Designer: **Jacob K. Nielsen, M.S., P.E.**

2025

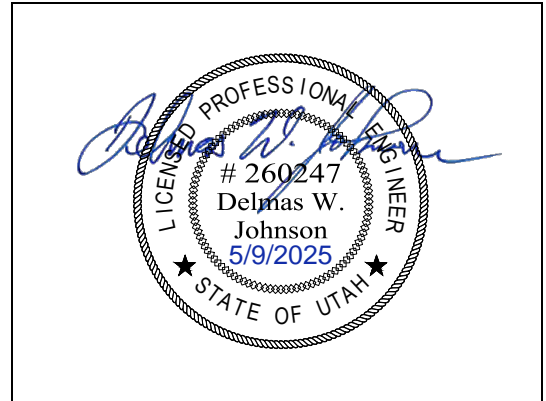
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**SEALS PAGE**  
**MP3.16 – NORTH BENCH PUMP STATION**  
**Project No. 513416337**

**PROJECT MANUAL PREPARED UNDER THE DIRECTION OF:**

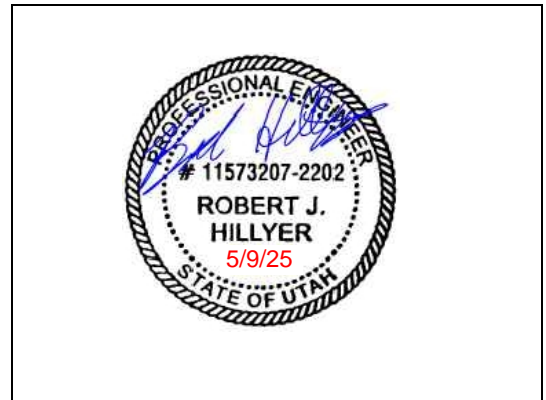
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- 1. Manual of Standard Plans published by the Utah Chapter of the American Public Works Association.

END OF DOCUMENT



**DOCUMENT 00 11 16**  
**INVITATION TO BID**

**PART 1 GENERAL**

**1.1 CONSTRUCTION CONTRACT**

- A. Bidders are invited to bid on the Construction Contract named and numbered as:  
**MP3.16 – NORTH BENCH PUMP STATION**  
**925 North Hilltop Road, Salt Lake City, UT 84103**  
**Project No. 513416337**
- B. For information about the award of this Construction Contract, contact Jason Draper, P.E., Chief Engineer at (801) 483-6751.
- C. Salt Lake City Corporation is migrating to the new **Utah Public Procurement Place (U3P)** platform, **BONFIRE**, starting in January 2025. To respond to solicitations, you will need to register at the new (U3P) BONFIRE by clicking **here**,  
<https://account.bonfirehub.com/login?flow=c5b60d04-a9a5-4f4a-b068-acc10ff55f4a>  
For first time users, click the link on the top right-hand side where you will see a **“Register”** button. Click that button and you will be taken through the registration process. It is recommended that you watch this **quick 5-minute video**,  
<https://share.vidyard.com/watch/nRJyoedyaNwRaWv43chZje?>, on how to register with BONFIRE, to aid in your registration process. Feel free to pause it as you go through the steps. If you have any questions or need assistance while using the platform, please consult the **online knowledge base**, <https://vendorsupport.gobonfire.com/hc/en-us> to explore the FAQs.
- D. All questions about technical requirements must be submitted through (U3P) BONFIRE. Please reach out to the BONFIRE Support Team at: [support@gobonfire.com](mailto:support@gobonfire.com).

**1.2 DESCRIPTION OF WORK**

- A. The location of the work is:  
**925 North Hilltop Road, Salt Lake City, UT 84103**
- B. The work to be performed consists of furnishing and installing the equipment, facilities, services, and appurtenances indicated in the Contract Documents. The Work generally includes, but is not limited to, the following:  
  
**The construction of a drinking water pump station facility. The pump station will be a masonry block building with standing seam metal roof equipped with five (5) vertical turbine drinking water pumps, motors and pump cans; exposed suction manifold piping inside an attached valve pit; valves, flow meter, and miscellaneous fittings and appurtenances; discharge pipelines connecting to existing distribution system; two bladder-style surge tanks; free standing 1 ton workstation crane; installation of a new gas-powered back-up generator and new natural gas connection and meter; storm drain and floor drain structures and piping; and HVAC system. Electrical work will include installation of a new power pole, buried power conduit, transformer, buried**

conduits for electrical connections; panels, including five (5) VFD panels; light poles and conduits for future security system; and electrical work associated with the booster pump station, and control wiring for system PLCs. RTU to be furnished by the OWNER. Site preparation will include excavation of unsuitable foundation material, backfill and compaction of approved material, forming and placement of concrete for footings, foundation walls, and floor slabs. Other site work will include clearing, grubbing, stripping and erosion control measures; asphalt surface placement and grading, concrete sidewalk; chain link and ornamental fencing, motorized access gate; temporary trail relocation; traffic control; and rock surface landscaping.

In conjunction with the construction of the new pump station, new valve vaults will be constructed to improve connections to the Morris Reservoir at the inlet and outlet. These connections are crucial to the functioning of the new pump station. Additional improvements are planned along the existing 18-inch City Creek Water Treatment Plant transmission pipeline from the air valve at the high point down to 18<sup>th</sup> Ave. Other valve vault improvements will be constructed near the Ensign Downs Low Tank. These include replacing a butterfly valve in the tank valve vault and constructing a new hydraulic control valve vault near Oak Forest Road and Capitol Oaks Lane.

Upon successful completion, commissioning and testing of new facilities the existing pump station will be decommissioned and components inside the building will be demolished/salvaged and removed, and the space will be renovated according to the Contract Drawings. Renovations will include slip lining the existing sewer lateral to 18<sup>th</sup> Ave.

### 1.3 BIDDERS' PRE-QUALIFICATION

A. Bidders are required to be pre-qualified for the Work.

### 1.4 BASIS OF BIDS

A. Bids will **only** be accepted through electronic submission through **(U3P) BONFIRE**.

### 1.5 CONTRACT TIME

A. The Work will be Substantially Complete within **730** calendar days after the Notice to Proceed. Calendar days for winter shut down are not included above.

### 1.6 EXAMINATION AND PROCUREMENT OF DOCUMENTS

A. Complete sets of Contract will be available for review as of **Thursday, May 9, 2025**, by logging into **(U3P) BONFIRE**. Bidders **must** register through the **(U3P) BONFIRE** platform to ensure access to all bid solicitation notifications and project related documents, such as access to plan holder copies of the project manual specifications and drawings. Please refer to Article 1.1C-D of the Invitation to Bid (Document 00 11 16), to obtain the links to register or questions about registration, please reach out to the **(U3P) BONFIRE** Support Team at [support@gobonfire.com](mailto:support@gobonfire.com).

B. **It is the responsibility of the bidder** to periodically check and download addenda(s), question and answer responses, or any additional information that may be posted during the bidding period. Bids received electronically through **(U3P)**

**BONFIRE** will be accepted. **Hard-copy paper bid submissions will no longer be accepted.** Refer to Article 1.4A of the Invitation to Bid (Document 00 11 16).

**1.7 PRE-BID CONFERENCE**

- A. A pre-bid conference will be held on **Thursday, May 15, 2025, at 2:00 PM**, 925 North Hilltop Road, Salt Lake City, Utah 84103.
- B. **ALL CONTRACTORS** intending to submit a bid are invited to attend to obtain relevant information concerning the project. Bidders should use the east lot along Research Rd for parking. Bidders are advised that information affecting drawings, specifications, conditions, scope of the Work, etc. may be discussed. OWNER assumes no obligation to disclose information discussed at the pre-bid conference to Bidders who do not attend. **Bidders who do not attend assume all risk of failure to attend.**

**1.8 BID SECURITY**

- A. The Bid Security amount must equal five (5%) percent of the total amount of the Bid. A PDF of the Bid Security must be included in the submission of the Bid Documents. **Bids utilizing cashier's checks or cash equivalent may not be submitted electronically.** The enclosed Bid Security will be valid for forty-five (45) days from the day of the Bid opening or until the Construction Contract has been recorded by the Office of the Recorder, subject to Article 2.11A hereof, as specified in the Instructions to Bidders (Document 00 21 13).

**1.9 BID LOCATION AND OPENING**

- A. Only bids submitted through **(U3P) BONFIRE** will be accepted no later than **2:00 p.m.**, as established by the clock at the **West Campus** office of the **Salt Lake City Department of Public Utilities (SLCDPU)**, located at **1805 West 500 South, Salt Lake City, Utah 84104**, on **Friday, May 30, 2025**. Bids delivered to any other location will not be accepted. Bids will be publicly opened and read by a Public Utilities representative.
- B. Successful and Unsuccessful Bid letters will be issued after the awarding of the Construction Contract. Bid tabulations may be requested through the Office of the City Recorder, once the project has been recorded, by accessing the following link:  
<https://www.slc.gov/attorney/recorder/>.
- C. This meeting will be held via Webex and in person at the SLCDPU West Campus location. To join SLCDPU for the Bid open meeting from the convenience of your computer, tablet, or smartphone, please use the link below. Bidders must submit final bid submission electronically through (U3P) BONFIRE. **The following project bid(s) are to be opened and read aloud in this open-to-the-public meeting:**

**SLCDPUENG Construction Open As-Read Bid Meeting for ) MP3.16 - North Bench Pump Station (513416337)**

**<https://saltlakecity.webex.com/saltlakecity/j.php?MTID=mdaed0b8298f9bf5b1856c5e146b97982>**

**Friday, June 6, 2025, 2:00 PM | 1 hour | (UTC-06:00) Mountain Time**

**Access code/Meeting number: 2498 450 4981**

**Password: openbid**

**Join by video system: Dial [24984504981@webex.com](https://saltlakecity.webex.com/saltlakecity/j.php?MTID=mdaed0b8298f9bf5b1856c5e146b97982)**. You can also dial 173.243.2.68 and enter your meeting number.

**Join by phone: +1-408-418-9388 United States Toll**

**1.10 RIGHT TO REJECT BIDS**

- A. OWNER reserves the right to reject any or all bids or to waive any informality or technicality in any bid if OWNER deems it to be in its best interest.

**1.11 VALIDITY PERIOD FOR BIDS**

- A. Bids shall remain valid for forty-five (45) days from the day of the Bid opening, unless the Bidder and the OWNER agree to extend the forty-five (45) days, but not to exceed sixty (60) days, see Article 2.11A hereof, as specified in the Instructions to Bidders (Document 00 21 13) or until a Construction Contract has been recorded.
- B. In the event a Bidder receives a Notice of Intent to Award and then withdraws their bid after Bid opening, but before expiration of said period, shall forfeit their Bid Security.

**1.12 GOVERNING LAWS AND REGULATIONS**

- A. This project does not require the payment of specific wage rates. Payroll submittals will not be required.
- B. Bidders on this Work will be subject to the applicable provisions of all federal rules, laws, and regulations or orders.

**1.13 AMERICANS WITH DISABILITIES (ADA)**

- A. Assisted listening devices or interpreting services are available for all public meetings. Salt Lake City Corporation complies with the American Disabilities Act (ADA). For further information, contact the TDD Number 801-483-6820.

**1.14 REPRESENTATION REGARDING ETHICAL STANDARDS FOR CITY OFFICERS AND EMPLOYEES AND FORMER CITY OFFICERS AND EMPLOYEES**

- A. A bid will not be accepted unless it contains the following representation.

**THE BIDDER, OFFEROR OR CONTRACTOR represents that it has not:**

- 1. Provided an illegal gift or payoff to a City officer or employee or former City officer or employee, or its relative or business entity.**
- 2. Retained any person to solicit or secure this contract upon an agreement or understanding for a commission, percentage, or brokerage or contingent fee, other than bona fide employees or bona fide commercial selling agencies for the purpose of securing business.**
- 3. Knowingly breached any of the ethical standards set forth in the City's conflict of interest ordinance, Chapter 2.44, Salt Lake City Code; or**
- 4. Knowingly influenced, and hereby promises that it will not knowingly influence, a City officer or employee or former City officer or employee to breach any of the ethical standards set forth in the City's conflict of interest ordinance, Chapter 2.44, Salt Lake City Code.**

**1.15 AWARD**

- A. The Construction Contract will be awarded in compliance with the City's Value-Based Procurement Program which takes into account certain factors in the Bidder's work environment. For more information about this Program please read SLC Procurement Rules 53-1A-20: VALUE BASED PROCUREMENT PROGRAM.

**END OF DOCUMENT**

# **DOCUMENT 00 21 13**

## **INSTRUCTIONS TO BIDDERS**

### **PART 1 GENERAL**

#### **1.1 DEFINED TERMS**

- A. Terms used in the Bid Documents that are defined in Article 1.1 of the General Conditions will have the meanings indicated in the General Conditions.
- B. General Conditions: as published in Document 00 72 00 in the current edition of the Manual of Standard Specifications by the Utah Chapter of the American Public Works Association.

#### **1.2 COPIES OF BID DOCUMENTS**

- A. Complete sets of Bid Documents must be used in preparing Bids. OWNER and ENGINEER assume no responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bid Documents.
- B. Bid Documents are made available to Bidder only for the purpose of obtaining Bids on the Work. No license or grant for any other use is given.
- C. Bidding Document copyrights shall remain with OWNER.
- D. All provisions of the current edition of the Manual of Standard Specifications and Manual of Standard Plans published by the Utah Chapter of the American Public Works Association that are applicable to the Work are made a part of the Contract Documents by reference. Those publications are available on the web at <http://utah.apwa.net>.
- E. Salt Lake City Department of Public Utilities has a document entitled "Standard Practices for Salt Lake City Public Utilities". (March 9, 2018 edition) The document is available from the West Campus office, located at 1805 West 500 South, Salt Lake City, Utah 84104.

#### **1.3 PRE-BID CONFERENCE**

- A. Representatives of the OWNER and the ENGINEER will be present at a Pre-Bid Conference to discuss the Project. Bidders are strongly encouraged to attend and participate at the conference. The ENGINEER will publish to (U3P) BONFIRE copies of the Pre-Bid Meeting Agenda and the Pre-Bid Meeting Attendance Log within twenty-four (24) hours up to forty-eight (48) hours after the meeting has concluded. An addendum will be issued if the ENGINEER/OWNER determines responses are necessary to clarify questions arising from the conference. The location and time of the conference are identified Article 1.7A in the Invitation to Bid (Document 00 11 16).

#### **1.4 EXAMINATION OF SITE AND CONTRACT DOCUMENTS**

- A. **In General:** Bidders are permitted to converse with ENGINEER or ENGINEER's personnel having knowledge of the Project, Plans, Specifications, material sites, or conditions generally prevailing in the area of the Project to aid in pre-bid investigations. OWNER is not bound by any statements or representations made by ENGINEER or ENGINEER's personnel before the Bid opening or award of the Construction Contract, nor for any assumptions or conclusions reached by a prospective Bidder as a result of such communication unless ENGINEER issues an Addendum to all prospective Bidders.
- B. **Access to Site:** The lands upon which the Work is to be performed, and rights-of-way and

easements for access thereto and other lands designated for use by Bidder in performing the Work are identified in the Contract Documents. All additional off-site lands and access thereto required for temporary construction facilities or storage of materials and equipment must be provided by Bidder.

- C. **Contract Documents:** The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 1.4; that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents; and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- D. **Bidder's Obligations:** The submission of a Bid constitutes acknowledgement that Bidder has complied with all bidding instructions. **It is the responsibility of each Bidder, before submitting a Bid to:**
  - 1. Examine the Contract Documents thoroughly.
  - 2. Visit the site to become familiar with local conditions that may affect cost, progress, performance, or furnishing of the Work;
  - 3. Consider federal, state, and local Laws and Regulations that may affect cost, progress, performance, or furnishing of the Work;
  - 4. Study and carefully correlate Bidder's observations with the Contract Documents; and
  - 5. Identify and notify ENGINEER in writing of all specific conflicts, errors, or discrepancies in the Contract Documents, and of any doubts of Bidder about their meanings. The failure or omission of any Bidder to receive or examine any form, instrument, Addendum, or other document, visit the site and become acquainted with conditions there existing, or attend the pre-bid conference, shall in no way relieve any Bidder from obligations with respect to Bidder's Bid or to the Construction Contract.
- E. **Deviations from the Terms of the Contract Documents:** OWNER will not accept any deviations whatsoever from the printed terms of the Agreement (Document 00 52 00) and the Contract Documents, except by Addendum or Change Order.

## 1.5 PHYSICAL CONDITIONS

- A. **In General:** Before submitting a Bid, each Bidder is responsible for review of OWNER's explorations, tests, and data concerning surface conditions, subsurface conditions, and Underground Facilities at or contiguous to the site, or otherwise, that may affect cost, progress, performance, or furnishing of the Work in accordance with the time, price, and other terms and conditions of the Contract Documents.
- B. **Surface and Subsurface Conditions:** Provisions concerning surface and subsurface conditions, if any, are set forth in the Geotechnical Data (Document 00 31 32). That document provides the identification of:
  - 1. Those reports of explorations and tests of subsurface conditions at the site that have been utilized by ENGINEER in preparing the Contract Documents; and
  - 2. Those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) at or contiguous to the site that have been utilized by ENGINEER in preparing the Contract Documents.

- C. **Underground Facilities:** Information and data indicated in the Contract Documents regarding Underground Facilities at or contiguous to the site is based upon information and data furnished to OWNER and ENGINEER by owners of such Underground Facilities. OWNER does not assume responsibility for the accuracy or completeness thereof other than as provided in paragraph 4.3A.2 of the General Conditions or unless expressly provided in the Modifications to the General Conditions (Document 00 73 10).
- D. **Additional Explorations:** On request in advance, and if possible, OWNER will provide to each Bidder access to the site to conduct any explorations and tests as each Bidder deems necessary for submission of a Bid. Bidder shall obtain permits, fill all holes, and clean up and restore the site to its former condition upon completion of such explorations. Bidder shall indemnify and save OWNER harmless during and after the performance of additional explorations.
- E. **Modifications to the Contract Documents:** Provisions concerning the adequacy of the data furnished for subsurface structures and underground facilities and the possibility of changes in the documents due to differing conditions appear in Articles 4.2 and 4.3 of the General Conditions.

## **PART 2 BIDDING PROCEDURES**

### **2.1 INTERPRETATIONS AND ADDENDA**

- A. All requests for interpretation of the Contract Documents shall be made in writing and submitted through **(U3P) BONFIRE** to the ENGINEER no later seventy-two (72) hours before the Bid opening. If required, ENGINEER will send a written interpretation to all the people receiving a set of Bid Documents in the form of a written Addendum. If a Bidder's request for interpretation is not responded to by the ENGINEER, the Bidder shall not rely on any interpretation in the request that is contrary to the intent and terms of the Contract Documents.
- B. OWNER will not be responsible for any explanations or interpretations, except those duly issued in the form of written Addenda.
- C. Addenda may also be issued to modify the Bidding Documents as deemed advisable by ENGINEER.
- D. Any Addenda so issued during the time of bidding shall be deemed to be included in the Bid. All Addenda shall become a part of the Contract Documents.
- E. Except to postpone the Bid opening, no Addenda shall be issued within forty-eight (48) hours before the Bid opening.

### **2.2 EQUIPMENT AND MATERIAL OPTIONS BEFORE OPENING**

- A. If a Bidder or Supplier wishes to use items of equipment or materials other than those identified in the Contract Documents, said Bidder or Supplier shall submit a written request for approval to ENGINEER at least ten (10) days before the date set for the Bid opening.
- B. The procedure for submission of any such request shall be as follows: submit 1) the written request and technical brochures and 2) a statement of variances. The statement of variances must list all features of the proposed substitution that differ from the Contract Documents and must further certify that the substitution has no other variant features. The brochure and



information submitted must be clearly marked showing make, model, size, options, and any other features and must include sufficient evidence for ENGINEER to evaluate each feature listed as a variance. If after installing the substituted product, an unlisted variance is discovered, CONTRACTOR shall immediately replace the product with a specified product at no cost to OWNER.

- C. Any approval of such a request by ENGINEER must be made not later than forty-eight (48) hours before the Bid opening. ENGINEER's failure to approve by such time shall be deemed a denial of the request.
- D. Any such approval is at the sole discretion of ENGINEER and will be in the form of an Addendum, issued to all Bidders holding Bid Documents, indicating that the additional equipment or materials are approved as equal to those specified for the Project.

## 2.3 BID SECURITY

- A. **Delivery of Bid Security:** Bidders must upload the Bid Security, in the form of a Bid Bond, to the OWNER electronically through **(U3P) BONFIRE** at the time of their Bid submission. If Bid Security is not uploaded with the Bid, the Bid shall not be read.
- B. **Amount of Bid security:** The Bid security amount must equal five (5%) percent of the total amount of the Bid. The total amount of the Bid shall be the sum of all items of the Bid, constituting the maximum amount of the possible award to the Bidder.
- C. **Bid Bond:** If a Bid Bond is used, the Bond shall guarantee that the Bidder, if awarded the Work, will promptly enter the Construction Contract to perform the Work in the manner required by the Contract Documents.
- D. **Cashier's Check or Cash Equivalent:** Cashier's Checks or cash equivalent will not be accepted as Bid Security through **(U3P) BONFIRE**. Bids utilizing cashier checks or cash equivalents for the Bid Security may not be submitted electronically and shall not be read.
- E. **Return of Bid Security:** **OWNER** will retain the PDF submission of Bid Security of all the Bidders. Bid Security will remain valid for forty-five (45) days after the date of the Bid opening or until the awarded Bidder receives a recorded Construction Contract. Access to this documentation will only be granted through a Government Records Access and Management Act (GRAMA) request through the Office of the Recorder, and only if the requested documentation is not protected information as defined in the UCA 63G-2-305. Please use the following link to research and request access at <https://www.slc.gov/attorney/recorder/>.
- F. **Default:** If the Bidder fails, within the time limit described in Article 3.6A, to enter into the Construction Contract and to deliver to OWNER a Performance Bond, Payment Bond, or any other Bonds or documents required by the Contract Documents after Notice of Intent to Award by OWNER, the Bidder shall forfeit the amount of the Bid Bond as liquidated damages to OWNER.

## 2.4 CONTRACT TIME AND PUNCH LIST TIME

- A. Provisions concerning Contract Time and Punch List Time are set forth in the Agreement (Document 00 52 00).



## 2.5 LIQUIDATED DAMAGES

- A. Provisions concerning liquidated damages are set forth in the Agreement (Document 00 52 00).

## 2.6 BID FORM

- A. The Bid Form (Document 00 41 00) identifies all forms comprising the Bid Documents. Additional copies may be obtained from ENGINEER.
- B. All names must be typed or printed under or near the signature. The signature must meet applicable State and City code.
- C. The Bid must contain an acknowledgment of receipt of all Addenda. The Addenda numbers must be filled in on the Bid Form.
- D. The Bidder's address, telephone number and email address for communications regarding the Bid must be shown on the first page of the Bid Form.
- E. The Bidder shall make no stipulations or alterations on the Bid forms. The Bidder must use only the Bid Form and Bid Schedules bound in the Contract Documents (unless updated forms are included in an addendum, in which case the Bidder shall use the updated forms).
- F. OWNER may waive any failure to comply with the requirements of this paragraph 2.6 if OWNER determines that such failure 1) is not material to the terms of OWNER's Bid Documents and process and does not render the Bid non-compliant with Laws and Regulations pertaining to bidding, or 2) involves ministerial or minor informalities that are evident from the Bid Documents or that can be waived without prejudice to other Bidders and that do not have a substantial effect on price.

## 2.7 BID SCHEDULE

- A. Any work or material that is specified in the Contract Documents or that is necessary because of the nature of the Work, but that is not listed separately in the Bid Schedule (Document 00 43 00), shall not be measured or paid for separately. The cost of such work or material shall be considered as included in the Contract Price.
- B. All blanks on the Bid Schedule (Document 00 43 00) must be completed in ink or by computer. If applicable, furnish both the unit and the total costs for each item. Numbers shall be stated in figures, and the signature of all people signing shall be in long hand. Any corrections, alterations or erasures made by the Bidder to the information the Bidder entered on the Bid Schedule shall be initialed in ink by the Bidder. OWNER may waive any failure to comply with the requirements of this paragraph if OWNER determines that such failure (1) is not material to the terms of OWNER's Bid Documents and process and does not render the Bid non-compliant with Laws and Regulations pertaining to bidding, or (2) involves ministerial or minor informalities that are evident from the Bid Documents or that can be waived without prejudice to other Bidders and that do not have a substantial effect on price.

## 2.8 SUBMISSION OF BIDS

- A. Bids shall be submitted at the time and place indicated in Article 1.9A-B, in the Invitation to Bid (Document 00 11 16).
- B. Methods of submission
  - a. must only be submitted electronically via **(U3P) BONFIRE**. Submit one (1)

electronic copy of the bid and any other corresponding documents that are listed as “REQUIRED” within the **(U3P) BONFIRE** bid posting, into a PDF file. Next upload your file(s), as requested in STEP 1: PROVIDE SUBMISSION INFORMATION section. Electronic submission responses must be successfully uploaded before or on the specified date of the Bid opening, prior to the 2 p.m. (MST) closing. After the Bidder uploads their response files, the Bidder will receive a confirmation number from **(U3P) BONFIRE**, of their successful submission.

- b. Responses submitted through **(U3P) BONFIRE** can be altered after the initial submission until the time prior to the bids closing. The bid submission to be altered can be accessed either by the registered Bidders using the **(U3P) BONFIRE** portal or through the confirmation email the bidder will receive upon a successful submission of the bid.
- c. **(U3P) BONFIRE** will only accept document types such as Word, Excel, or PDF, as it is specified, and the maximum file size accepted is 1000 MB. Uploading documents that are not to the specification of the file type requested, will be rejected with the following message, “*File type not allowed*”. Such actions may cause your proposal to be deemed as "non-responsive".
- C. Alternate bids, other than those called for in the Bid form, will not be considered.
- D. No oral, email, or hard copy bids will be considered or accepted. OWNER will only accept responses submitted electronically through **(U3P) BONFIRE**.

## 2.9 MODIFICATIONS AND WITHDRAWAL OF BIDS

- A. At any time before the Bid opening, Bids may be modified or withdrawn; refer to Article 2.8B in the Instructions to Bidders (Document 00 21 13).
- B. If the Bidder requests to withdraw their Bid Proposal after Bids have been opened and read to the public, the Bidder has two (2) business days after Bids are opened, Bidder may file written notice, email submission of said notice is acceptable, with the OWNER that there was a substantial mistake made in the preparation of their Bid. Bidder must thereafter promptly demonstrate Bidder's mistake to the reasonable satisfaction of the OWNER. If the OWNER agrees, the Bidder may withdraw their Bid.
- C. The Bidder’s original submission, if approved by the OWNER for withdrawal, will remain with the “life” of the project as recorded of procurement. The Bidder’s Bid will be labeled in the procurement records as, “WITHDRAWN PER BIDDERS REQUEST”. The Bidder may satisfy the OWNER’s written notice requirement for the withdrawal of their bid, by email submission. **It is the responsibility of the bidder** to confirm with the OWNER that the Bidder’s notice for withdrawal has been received.

## 2.10 OPENING OF BIDS

- A. Bids will be downloaded and opened via **(U3P) BONFIRE**, then read aloud publicly unless obviously “non-responsive”. An abstract of the amounts of the base schedule of prices and any alternate schedules will be made available for review after the opening of Bids.
- B. Bids attempting submission to the bid post via **(U3P) BONFIRE** after the time specified in the Invitation to Bid (Document 00 11 16) will be rejected by the system.

## **2.11 BIDS SUBJECT TO ACCEPTANCE FOR 45 DAYS**

- A. Subject to Paragraph 2.3E hereof, Bids remain subject to acceptance for forty-five (45) days after the day of the Bid opening. OWNER may, in its sole discretion, release any Bid and return the Bid security before that date. OWNER and Bidder may agree to extend the forty-five (45) day deadline, but not to exceed sixty (60) days.

## **2.12 NONDISCRIMINATION IN EMPLOYMENT**

- A. Work under this Bid will obligate the Bidder and Subcontractors not to discriminate in employment practices.
- B. Bidders must, if requested, submit a compliance report concerning employment practices and policies in order to maintain their eligibility to receive the award of the Construction Contract.
- C. Equal opportunity employment shall be reflected in the racial and sexual composition of Bidder's work force and OWNER urges an affirmative action program to overcome under-utilization.
- D. Bidders are advised that the Construction Contract and its performance are subject to the applicable provisions of all Laws and Regulations. Bidder will be obligated, upon written request, to give all applicable assurances of compliance in connection therewith.
- E. If federal nondiscrimination requirements are applicable, Bidder must be fully knowledgeable and comply with such requirements. Refer to Community Development Block Grant Supplementary Conditions (CDBG) (Document 00 73 12) or Federal Aviation Administration Supplementary Conditions as applicable.

## **2.13 SECTION 3, HOUSING AND URBAN DEVELOPMENT ACT OF 1968**

- A. If Work under this Bid is funded with a federal community development block grant the requirements of Section 3 of the Housing and Urban Development Act of 1968 may apply to the Bidder and its Subcontractors. OWNER encourages the use of the State of Utah Section 3 register for all subcontracting  
<https://jobs.utah.gov/housing/affordable/owhlf/section3/hudsection3.html>.
- B. Bidder will be obligated to give all applicable assurances of compliance in connection with this Section 2.13 at any time.

# **PART 3 AWARD OF CONSTRUCTION CONTRACT**

## **3.1 QUALIFICATIONS OF BIDDERS**

- A. Within seven (7) calendar days of the Owner's request, a bidder whose bid is under consideration for award shall submit to the Owner the following information for the bidder. The Owner may request like information on the bidder's Subcontractors, or bidder's Suppliers or any other information the Owner may require.
  - 1. A current financial statement for the Work (as provided to the bonding company);
  - 2. A chronological list of "completed" construction work done by Bidder during the last 3 years, including project name, address, owner, contract name, and current telephone number;
  - 3. Work Under Contract Report (Document 00 43 37);
  - 4. The proposed organizational structure for the project: firm ownership, project manager,

- progress scheduler, and CONTRACTOR's Resident Superintendent's resume;
5. Owned and rented equipment that is to be used to do the Work;
  6. Investigations, arbitrations, litigation, or claims that are pending, threatened, settled, or disposed of within the last 3 years;
  7. Evidence of ability to perform and complete the Work in a manner and within the time limit specified. As a minimum, identify specific projects similar to the Work in physical size, cost, and commercial nature. If the work experiences of the project manager and Resident Superintendent designated to construct this project are different than that of Bidder, provide resumes of their work history. Include their actual project titles and indicate their actual responsibilities on each given project;
  8. Names of three (3) projects of similar size and nature that the Resident Superintendent has completed. Include the name, address, and telephone number of the office contracting for each project.
  9. Information so OWNER's Labor Relations Specialist can certify that Bidder has an acceptable Utilization Plan that offers economic opportunities to low and very low income persons and that Bidder qualifies as a Section 3 Contractor; and
  10. Such other data as may be called for in the Supplementary Instructions to Bidders (Document 00 22 13) (if any). OWNER will hold all requested information confidential and, upon request, shall return such information to Bidder after acceptance or rejection of Bidder's Bid.
- B. Untimely response by Bidder will release OWNER of any obligation to further negotiate or consider Bidder's Bid.

### **3.2 EVALUATION OF BIDS**

- A. OWNER reserves the right: 1) to reject any and all Bids; 2) to waive minor informalities in the Bid Schedule and elsewhere so long as the informalities (a) are not material to OWNER's Bid Documents and process and do not render the Bid non-compliant with Laws and Regulation pertaining to bidding, or (b) involve ministerial or minor informalities that are evident from the Bid Documents or that can be waived without prejudice to other Bidders and that do not have a substantial effect on price; 3) to negotiate and agree to contract terms with the successful Bidder; and 4) to disregard non-conforming, non-responsive, unbalanced, or conditional Bids.
- B. OWNER reserves the right to reject any Bid if OWNER believes that it would not be in the best interest of the Project or OWNER to make an award to that Bidder. Such rejection may be because the Bid is non-responsive, or Bidder is unqualified or of doubtful ability, or Bidder's Resident Superintendent is unqualified or of doubtful ability, or the Bid or Bidder fails to meet any other pertinent standard or criteria established by OWNER in the Supplementary Instructions to Bidders (Document 00 22 13).
- C. OWNER will consider the qualifications of Bidder and such alternates, prices, and other data as may be requested in the Bid Form (Document 00 41 00), Bid Schedule (Document 00 43 00), or written requests issued prior to OWNER's Notice of Intent to Award the Construction Contract. OWNER will consider Bidder's compliance with Section 3.24.115, Salt Lake City Code. See Document 00 22 16 Supplementary Instructions to Bidders.

- D. OWNER may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for portions of the Work as provided in the Proposed Subcontractor Form (Document 00 43 36). OWNER will consider Bidder's compliance with Section 3.24.115, Salt Lake City Code. See Document 00 22 16 Supplementary Instructions to Bidders.
- E. OWNER may consider the operating costs, maintenance requirements, performance data, and guarantees of materials and equipment when such data is required to be submitted prior to the Notice of Intent to Award the Construction Contract.
- F. To establish qualifications of Bidder, OWNER may request such data indicated in Article 3.1 hereinabove and conduct such investigations as OWNER deems appropriate.
- G. If the Construction Contract is to be awarded, it will be awarded to the most responsive and lowest, qualified, responsible Bidder as determined by OWNER. Alternates may be accepted depending upon availability of OWNER funds. Bid alternates will be considered in determining the most responsive, lowest, qualified, and responsible Bidder.
- H. ENGINEER will evaluate Bid Schedules as follows:
  - 1. ENGINEER will resolve discrepancies in the multiplication of quantities of Work items and unit prices in favor of the unit prices.
  - 2. Prices written out in words shall govern over prices written out in numbers.
  - 3. ENGINEER will resolve discrepancies between the indicated sum of any column of figures and the correct sum thereof in favor of the correct sum.
  - 4. Bids shall not contain any recapitulations of or changes in the work to be done.
  - 5. ENGINEER may accept a Bid despite obvious errors in a Bid Schedule, such as a failure to include unit prices or a misplaced decimal point, as long as ENGINEER reasonably can discern the intention of Bidder as to the amounts to be bid.

### 3.3 SUBCONTRACTORS, SUPPLIERS AND OTHERS

- A. Bidder shall not subcontract more than 75 percent of the dollar value of the total contemplated Work (exclusive of the supply of materials and equipment to be incorporated in the Work) without OWNER's written approval.
- B. Conflict of interest restrictions pertaining to Subcontractors are described in paragraph 6.5H of the General Conditions.

### 3.4 CONTRACT SECURITY AND OTHER SUBMITTALS

- A. **Performance Bond (Document 00 61 13) and Payment Bond (Document 00 61 14):** OWNER's requirements as to Performance and Payment Bonds are as set forth in the Modifications to General Conditions (Document 00 73 10). Specific requirements are set forth in the Performance Bond (Document 00 61 13) and the Payment Bond (Document 00 61 14).
  - 1. Bidder should carefully examine the form of the Bonds.
  - 2. When the successful Bidder delivers the executed Construction Contract to OWNER, it must be accompanied by the required Performance and Payment Bonds (using Documents 00 61 13 and 00 61 14, respectively).
- B. **Proposed Subcontractor Form (Document 00 43 36):** Bidder must provide this report

form to OWNER within 24 hours after ENGINEER's request. See Bid Form, paragraph 1.5B (Document 00 41 00) for additional information. The form shall list the name and address of each Subcontractor who will perform work or labor or render service to Bidder at the site of the Work, or a Subcontractor who, off the job site, will specially fabricate a portion of the Work or improvement according to detail Drawings. In each instance, the nature and extent of any Work to be subcontracted in an amount in excess of 2 percent of the Bid sum shall be described. Bidder must have the written consent of OWNER to substitute for any of the Subcontractors or Suppliers designated or to employ any Subcontractor or Supplier that is not listed.

- C. **Bidder Status Report (Document 00 43 38):** Bidder must submit the completed form upon ENGINEER's request or after Bidder receives the Notice of Intent to Award.
- D. **Other Information:** When a determination has been made to award the Construction Contract, Bidder is required, before the award or after the award, or both, to furnish such other information as ENGINEER requests.

### 3.5 **ADJUSTMENTS TO THE COST OF THE WORK AFTER OPENING OF BIDS**

- A. The Contract Price identified in the Agreement (Document 00 52 00) represents the Cost of the Work that is to be paid by OWNER to CONTRACTOR. Adjustments to the Contract Price that are agreed to between OWNER and the successful Bidder shall be effected by signing an Agreement Supplement.

### 3.6 **SIGNING OF AGREEMENT**

- A. Within 10 days, (or such longer period of time that OWNER in its discretion may allow) after OWNER gives Notice of Intent to Award the Construction Contract to the successful Bidder, Bidder shall pick up, sign, and return the required number of copies of the Agreement (Document 00 52 00) and attached documents to OWNER with the required Bonds. A minimum of 2 originals will be signed. One executed original will be returned to Bidder.
- B. Transfers, delegations, or assignments of interests in the Contract Documents are prohibited, unless prior written authorization is received from OWNER.
- C. At and from the time of Bidding through the completion of the Work, Bidder shall be properly licensed to do the Work and shall be in compliance with the license laws of the State of Utah, Salt Lake City and Salt Lake County.

## **PART 4 MISCELLANEOUS**

### 4.1 **EQUIPMENT AND MATERIAL OPTIONS AFTER BID OPENING**

- A. The Construction Contract, if awarded, will be on the basis of materials and equipment described in the Drawings, Specifications, and any Addenda.
- B. The procedure for submitting an application for substitution after the effective date of the Construction Contract is set forth in Article 6.4 of the General Conditions.

**END OF DOCUMENT**

**DOCUMENT 00 22 13**  
**SUPPLEMENTARY INSTRUCTIONS TO BIDDERS**

Add the following paragraph to Article 3.3.

**3.3 SUBCONTRACTOR, SUPPLIERS AND OTHERS**

C. The following firms, that have been under contract to the OWNER in the design phase of the Work, shall not be used as subcontractors by the CONTRACTOR.

1. Design Consultant: Hansen, Allen & Luce, Inc.
2. Structural Consultant: Calder Richards Structural Engineers
3. Electrical/HVAC Consultant: Heath Engineering
4. Geotechnical Consultants: Applied Geotechnical Engineering  
Consultants, Inc.
5. Surveying Consultant: \_\_\_\_\_
6. Other: \_\_\_\_\_
7. Other: \_\_\_\_\_

Add the following article to Part 4.

**4.2 PARTNERING**

- A. Refer to Section 01 31 20 for description of partnering requirements.
- B. OWNER's consultants listed in this project manual will be partners to the project.

END OF DOCUMENT

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**DOCUMENT 00 22 16**  
**SUPPLEMENTARY INSTRUCTIONS**  
**(Building Improvement or Public Works Projects)**

**PART 1 GENERAL**

**1.1 INTRODUCTION**

- A. OWNER has determined that in accordance with Section 3.24.115 of the Salt Lake City Code the health, safety, and general welfare of the citizens of Salt Lake City are reasonably furthered by OWNER's Building Improvement or Public Works Projects (BIPW) procurement code requirements.

**1.2 BIPW PROGRAM**

- A. The BIPW program is set forth in Salt Lake City Code Section 3.24.115 and can be found at the following web address: <https://codelibrary.amlegal.com/codes/saltlakecityut> Click on "CITY CODE of SALT LAKE CITY, UTAH" click on "TITLE 3 – REVENUE AND FINANCE", click on "CHAPTER 3.24 PROCUREMENT", click on "3.24.115: BUILDING IMPROVEMENT OR PUBLIC WORKS PROJECTS"
- B. Bidder shall submit with its bid the Qualified Health Insurance Coverage Form. In this form Bidder certifies that the information given is true as of the time of submitting its bid. The information will be used in the manner stated in paragraph "F" below to evaluate "responsiveness" if bids are within 10% of each other. This form is used by Bidder to certify that Bidder and all subcontractors of Bidder with a subcontract value of \$1,000,000 or more at the original execution of the subcontract working on the project have and will maintain qualified health insurance coverage in compliance with Salt Lake City Code 3.24.115 for the duration of the contract. Neither the failure to submit this form nor checking "No" regarding Qualified Health Insurance Coverage will render the bid non-responsive.
- C. Bidder shall submit with its bid the information shown on the Work Environment Certification Form (Document 00 43 46). In that form Bidder certifies that the information given is true as of the time of submitting its bid. If "Yes" is not certified for each item, the bid will be rejected as non-responsive. See Section 3.24.115 of the Salt Lake City Code. That form is used by Bidder to certify that Bidder and all subcontractors of Bidder working on the project have and will maintain 1) a drug and alcohol testing policy; 2) a program to recruit and/or employ veterans; 3) a job training program; 4) a safety program; and 5) a formal policy of non-discrimination in compliance with Salt Lake City Code Section 3.24.115 for the duration of the contract
- D. OWNER reserves the right to review or audit any information provided by Bidder to make its evaluation. Bidder shall provide or furnish access to any necessary records or other information in order to permit OWNER to verify Bidder's and/or Subcontractor's certifications. Bidder shall provide or furnish access to such records and information no later than three (3) business days after OWNER issues a written request for the same.

- E. The Building Improvement or Public Works projects procurement requirements will only apply to contracts of \$2,000,000 or more, as determined by the ENGINEER's estimate.
- F. If more than one Bidder answers "YES" to the question on the Qualified Health Insurance Certification Form (Document 00 43 45), the following analysis will apply: A Bidder who has and will maintain an offer of qualified health insurance coverage under the Building Improvement or Public Works projects procurement requirements and whose bid is not more than 10 percent higher than the bid of another Bidder who does not have such insurance, will be deemed the more responsive Bidder. If two or more Bidders are judged to be equally responsive, OWNER will make the award to the Bidder with the lowest bid price. For purposes of this paragraph "F", references to "Bidder" with respect to qualified health insurance coverage shall be deemed to refer also to any subcontractors with a subcontract value of \$1,000,000 or more at the original execution of the subcontract under such Bidder.
- G. Qualified Health Insurance Coverage documentation for bidder with a contract value of \$2,000,000 or more or each subcontractor of bidder with a subcontract value of \$1,000,000 or more which shall include the following two documents:
  - 1. An original statement on company letterhead signed by a duly authorized officer of the bidder/subcontractor stating that the bidder/subcontractor will maintain qualified health insurance coverage for the duration of the contract as defined in Section 26-40-115, Utah Code Annotated, as amended, or its successor in compliance with Salt Lake City Code 3.24.115.
  - 2. A written statement of actuarial equivalency from either:
    - a. An actuary selected by the bidder/subcontractor or bidder's/subcontractor's health insurer; or
    - b. An underwriter who is responsible for developing the bidder's/subcontractor's health insurance premium rates.

### 1.3 BIPW PROGRAM

- A. In situations in which the factors listed in the Qualified Health Insurance Certification form affect the award of the Bid, the winning Bidder will be required to enter into a Qualified Health Insurance Supplemental Agreement (Document 00 54 16) with OWNER.

### 1.4 Important information for Bidder and all Subcontractors of the successful Bidder

- A. Salt Lake City Code Section 3.24.115 paragraph C.4 states the following:
  - 1. A bidder who does not certify compliance with the factors in subsections C1b to C1f of this section and, if there is a subcontract, subsections C2b to C2f of this section, shall be deemed nonresponsive and shall be disqualified.
- B. Refer to the Bid Form (Document 00 41 00) for the sequence of submittals to ensure compliance with Salt Lake City Code Section 3.24.115.

END OF DOCUMENT

**DOCUMENT 00 41 00**  
**BID FORM**

**PART 1    GENERAL**

**1.1    BIDDER**

- A. Name: \_\_\_\_\_
- B. Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- C. Telephone number: \_\_\_\_\_
- D. Email address: \_\_\_\_\_
- E. Tax identification number: \_\_\_\_\_
- F. Bidder holds license number \_\_\_\_\_, issued by the Utah State Department of Commerce, Division of Occupational and Professional Licensing. Bidder is licensed to practice as a \_\_\_\_\_ Contractor. The license expiration date \_\_\_\_\_.

**1.2    NOTICE**

- A. Pursuant to Section 58-55-501(8), Utah Code Annotated (UCA), it is unlawful to submit a bid for any work for which a license is required under Chapter 55 of Title 58, UCA, by a person or other business entity not licensed or excepted from licensure as a contractor under Chapter 55 of Title 58, UCA. Pursuant to Section 58-55-503(1), UCA, contracts for the work may not be awarded to any person or other business entity that violates Sections 58-55-501(8) UCA, in submitting its Bid.

**1.3    CONSTRUCTION CONTRACT**

- A. **MP3.16 – NORTH BENCH PUMP STATION, Project No. 513416337**
- B. The ENGINEER's estimate for this project is over \$2,000,000.00.
- C. This project is not CDBG funded.
- D. This project does require a permit to work in the Public Way from Salt Lake City Engineering, 349 South 200 East, Suite 100. If such a permit is required, Section 6.7 (H) (1) (d) of Document 00 73 10 (Modifications to the General Conditions) shall apply.

**1.4    ADDENDA**

- A. Bidder hereby acknowledges receipt of the following Addenda.

\_\_\_\_\_  
(list Addenda numbers here)

## 1.5 SUBMITTALS

### A. With Bid:

1. This Bid Form (Document 00 41 00).
2. Bid Schedule (Document 00 43 00).
3. Bid bond.
4. Voluntary Submittals: (If the documents noted below are included in the Project Manual).
  - a. Economic Opportunities Form (Document 00 43 41 – CDBG Projects only). Bidder may be at a competitive disadvantage if it does not submit the Economic Opportunities Form.
  - b. Value Program Form (Document 00 43 40) Bidder may be at a competitive disadvantage if it does not submit the Value Program Form.
5. Mandatory Submittals (If the documents noted below are included in the Project Manual).
  - a. Qualified Health Insurance Certification Form (Document 00 43 45), checking “No” will not render the bid non-responsive. That form is used by Bidder to certify whether Bidder and all subcontractors of Bidder working on the project have and will maintain an offer of qualified health insurance in compliance with Salt Lake City Code Section 3.24.115 for the duration of the contract.
  - b. Work Environment Certification Form (Document 00 43 46) If the Bidder does not certify yes to each question in Document 00 43 46 the bid will be rejected as non-responsive. That form is used by Bidder to certify that Bidder and all subcontractors of Bidder working on the project have and will maintain 1) a drug and alcohol testing policy; 2) a program to recruit and/or employ veterans; 3) a job training program; 4) a safety program; and 5) a formal policy of non-discrimination in compliance with Salt Lake City Code Section 3.24.115 for the duration of the contract. See Section 3.24.115 of the Salt Lake City Code and Article 1.4 of Section 00 22 16 Supplemental Instructions.

### B. Due diligence letter to Bidder: If Bidder receives a due diligence letter from OWNER after bid opening, Bidder must submit the following documents to OWNER after ENGINEER’s request.

1. Document 00 43 36: Proposed Subcontractor Form.
2. Document 00 43 37: Work Under Contract Report.
3. Document 00 43 38: Bidder Status Report.
4. Other information requested and as defined in Article 3.1 and 3.4 D of Document 00 21 13.

### C. After Notice of Intent to Award: If Bidder receives a notice of intent to award the Contract from OWNER after bid opening, Bidder must submit the following documents to OWNER.

1. Document 00 52 00: Agreement.
2. Document 00 61 13: Performance Bond.

3. Document 00 61 14: Payment Bond.
4. Document 00 62 16: Applicable Insurance Certificate.
5. Supplementary Submittals (if applicable):
  - a. Copy of letter from OWNER's Labor Relations Specialist certifying that Bidder has an approved utilization plan that offers economic opportunities to low and very low income persons.
  - b. Document 00 54 00: Agreement Supplement.
  - c. Document 00 54 15: Value Program Supplemental Agreement.
  - d. Document 00 54 16: Qualified Health Insurance Supplemental Agreement.
  - e. Document 00 54 17: Economic Opportunities Supplemental Agreement.

## 1.6 DEFINITIONS

- A. **Bid Documents:** The Bid Documents consist of the Invitation to Bid, the Instructions to Bidders, any Supplementary Instructions to Bidders, this Bid form, any supplements (or post-bid supplements), the Bid Schedule, any data listed by and limited to the provisions in the Geotechnical Data Document, and the Bid Bond.
- B. **Bid Bond:** AIA Document A310 as published by the American Institute of Architects, 1736 N. Y. Ave. N. W. Washington, D.C. 20006 or one substantially the same and acceptable to OWNER.
- C. **HUD:** United States Department of Housing and Urban Development.

## PART 2 COVENANTS

### 2.1 BIDDER TO ENTER INTO AN AGREEMENT

- A. **In General:** Bidder agrees, if this Bid is accepted, to enter into a Construction Contract with OWNER to perform and furnish all Work specified or indicated in the Contract Documents at the Contract Time and Contract Price identified in the Agreement (Document 00 52 00).
- B. **Agreement Supplement:** If it becomes necessary to further define the Work, Contract Price, Contract Time, or some other portion of the Construction Contract before signing the Agreement (Document 00 52 00), ENGINEER shall prepare an Agreement Supplement (Document 00 54 00) describing such change. OWNER shall have sole discretion in determining the necessity of preparing such a contract modification. If the Agreement Supplement is acceptable to Bidder, Bidder shall execute the Agreement Supplement before or concurrently with the execution of the Agreement (Document 00 52 00).
- C. If Bidder was awarded the Construction Contract in part as a result of OWNER's Value-Based Procurement Program, Bidder shall enter into a Value Program Supplemental Agreement (Document 00 54 15) with OWNER concurrently with its execution of the Agreement (Document 00 52 00).

- D. If Bidder was awarded the Construction Contract in part as a result of OWNER's Qualified Health Insurance program, Bidder shall enter into a Qualified Health Insurance Supplemental Agreement (Document 00 54 16) with OWNER concurrently with its execution of the Agreement (Document 00 52 00).

## 2.2 **BIDDER ACCEPTS TERMS AND CONDITIONS**

- A. Bidder accepts all of the terms and conditions of the Bid Documents, including without limitation those dealing with the disposition of Bid security.
- B. Bidder must pick up, sign, and submit, the required number of copies of the Agreement (Document 00 52 00) with the Bonds and other documents required by the Agreement within 10 days (or such longer period of time that OWNER in its discretion may allow) after the date of OWNER's Notice of Intent to Award the Construction Contract.

## 2.3 **REPRESENTATION OF BIDDER**

- A. In submitting this Bid, Bidder represents, as more fully set forth in the Instructions To Bidders (Document 00 21 13), that:
1. **Nature of the Work:** Bidder has become familiar with the nature and extent of the Contract Documents, Work, site, locality, and all local conditions and Laws and Regulations that in any manner may affect cost, progress, performance, or furnishing of the Work.
  2. **Surface and Subsurface Conditions:** Bidder has studied carefully all reports and drawings of subsurface conditions and drawings of physical conditions that are identified in the Geotechnical Data (Document 00 31 32) (if any).
  3. **Underground Utilities:** Bidder has reviewed and checked all information and data shown or indicated on the Contract Documents with respect to existing Underground Facilities at or contiguous to the site.
  4. **Bidder Investigation:** Bidder has correlated the results of all observations, examinations, investigations, explorations, tests, reports, and studies with the terms and conditions of the Contract Documents.
  5. **Discrepancy Resolutions:** Bidder has given ENGINEER written notice of all conflicts, errors, or discrepancies that Bidder has discovered in the Contract Documents and acknowledges that all written resolutions thereof issued by ENGINEER before Bid opening, are acceptable to Bidder.

## 2.4 **OWNER'S RIGHTS AT BID AWARD**

- A. Bidder agrees that OWNER has the right to reject this Bid or to award the Work or any part thereof to the undersigned at the prices stipulated. Bidder agrees to make no claim for damages for such rejection or award.
- B. If the Bid is rejected, then the Bid Security will be considered invalid. Once the Construction Contract has been filed and recorded with the Office of the Recorder, access to this documentation will only be granted through Government Records Access and Management Act (GRAMA) request through the Office of the Recorder, and only if the requested documentation is not protected information as defined in the UCA 63G-2-305. Please use the following link to research and request access at <https://www.slc.gov/attorney/recorder/>.

- C. If the Bid is accepted, OWNER shall notify the Bidder of the OWNER's intent to award the Construction Contract to Bidder. Bidder shall have ten (10) days (or such longer period of time that OWNER in its discretion may allow) to sign and return the Agreement (Document 00 52 00) to OWNER. If Bidder fails to sign the Agreement, the Bid Security, at the OWNER's option, shall be claimed and cashed and the amount thereof paid to the OWNER as liquidated damages for the failure of Bidder to comply with the terms of the Bid.
- D. Bidder agrees that the Bid may be rejected if the submittals listed in this Document or the Notice of Intent to Award are not submitted within the time listed in the Notice of Intent to Award (or described in paragraph 2.4C hereof).

## **2.5 NON-COLLUSION; ETHICS**

- A. Bidder represents that the Bid is genuine. The Bid is not made in the interest of or on behalf of any undisclosed person, firm, or corporation.
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid.
- C. Bidder has not solicited or induced any person, firm, or corporation to refrain from bidding.
- D. Bidder has not sought by collusion to obtain for itself any other advantage over any separate Bidder or over OWNER.
- E. **REPRESENTATION REGARDING ETHICAL STANDARDS FOR CITY OFFICERS AND EMPLOYEES AND FORMER CITY OFFICERS AND EMPLOYEES**

**Bidder represents that it has not:**

- 1. Provided an illegal gift or payoff to a City officer or employee or former City officer or employee, or his or her relative or business entity.**
- 2. Retained any person to solicit or secure this contract upon an agreement or understanding for a commission, percentage, or brokerage or contingent fee, other than bona fide employees or bona fide commercial selling agencies for the purpose of securing business.**
- 3. Knowingly breached any of the ethical standards set forth in the City's conflict of interest ordinance, Chapter 2.44, Salt Lake City Code; or**
- 4. Knowingly influenced, and hereby promises that it will not knowingly influence, a City officer or employee or former City officer or employee to breach any of the ethical standards set forth in the City's conflict of interest ordinance, Chapter 2.44, Salt Lake City Code.**

## **2.6 BID PRICING**

- A. Bidder will complete the Work for the prices listed in the Bid Schedule (Document 00 43 00). Bidder agrees that quantities for Unit Price Work are not guaranteed. (Refer to Article 11.7 of the General Conditions (Document 00 72 00)).

**2.7 SUBSTANTIAL COMPLETION, PROJECT COMPLETION, AND LIQUIDATED DAMAGES**

- A. Bidder agrees that the Work will be Substantially Complete and ready for Final Inspection on or before the expiration of the Contract Time indicated in the Agreement (Document 00 52 00).
- B. Bidder agrees that the Work will be complete and ready for final payment in accordance with Article 14.9 of the General Conditions (Document 00 72 00) on or before the expiration of the Punch List Time indicated in the Agreement.
- C. Bidder accepts the provisions of the Agreement (Document 00 52 00) as to liquidated damages in the event of failure to complete the Work on time and in accordance with the Contract Documents.

**PART 3 EXECUTION**

**3.1 EFFECTIVE DATE**

- A. Bidder executes this Bid and declares it to be in effect as of the \_\_\_\_\_ day of \_\_\_\_\_ - \_\_\_\_\_, 20 \_\_\_\_\_.

**3.2 BIDDER'S SUBSCRIPTION**

- A. Bidder's Signature: \_\_\_\_\_
- B. Please print Bidder's name here: \_\_\_\_\_
- C. Title: \_\_\_\_\_

END OF DOCUMENT



**DOCUMENT 00 43 00**  
**BID SCHEDULE**

**PART 1 GENERAL**

**1.1 DOCUMENT INCLUDES**

- A. Price schedules.
- B. Measurement and payment provisions.

**1.2 CONSTRUCTION CONTRACT**

**A. MP3.16 – NORTH BENCH PUMP STATION**

**925 North Hilltop Road, Salt Lake City, UT 84103**

**Project No. 513416337**

**1.3 REFERENCES**

- A. APWA Section 01 29 00: Payment Procedures.
- B. Document 00 52 00: Agreement.

**1.4 SCHEDULE TO BE ADDED TO THE AGREEMENT**

- A. This document will be added to the Agreement by reference.

## PART 2 PRICE SCHEDULES

### 2.1 GENERAL

- A. Number of schedules in Base Bid: Two.
- B. Number of alternate schedules: Two.
- C. For progress payment procedures, see APWA Section 01 29 00 requirements.

### 2.2 BASE BID

- A. **CAUTION: Bidder shall complete all blanks in the following price schedule(s). Failure to do so may cause the bid to be declared non-responsive by ENGINEER.**

<b>Schedule A</b> <b><u>NORTH BENCH PUMP STATION AND ASSOCIATED PIPING</u></b>				
Item	Specification Reference Number Classification of Work	Quantity and Unit	Unit Price	Total Cost
	<b>Water Services – Project No. 513416337</b>			
A.01	Mobilization/Demobilization	1 Lump Sum	N/A	\$
A.02	Construction Surveying	1 Lump Sum	N/A	\$
A.03	SWPPP	1 Lump Sum	N/A	\$
A.04	Materials Testing	1 Lump Sum	N/A	\$
A.05	Clearing, Grubbing, Stripping, and Erosion Control Measures	1 Lump Sum	N/A	\$
A.06	Traffic Control	1 Lump Sum	N/A	\$
A.07	Trail Management Including Signage and Temporary Relocation	1 Lump Sum	N/A	\$
A.08	Install Temporary Construction Fencing	1 Lump Sum	N/A	\$
A.09	General Allowance	1 Lump Sum	\$663,000	\$663,000
A.10	Special Permitting Allowance	1 Lump Sum	\$25,000	\$25,000
A.11	Rocky Mountain Power Electrical Power Transformers	1 Lump Sum	N/A	\$
A.12	Not Used	-	-	-
A.13	Furnish and Install Buried Power Conduits	660 Linear Feet	\$	\$
A.14	Furnish and Install Natural Gas Generator	1 Lump Sum	N/A	\$

A.15	Natural Gas Connection and Meter	1 Lump Sum	N/A	\$
A.16	Furnish and Install 2-inch PE Natural Gas Service	685 Linear Feet	\$	\$
A.17	Site Grading, Backfill, and Compaction for North Bench Pump Station	990 Cubic Yards	\$	\$
A.18	Excavation and Structural/Flow Fill for North Bench Pump Station	1 Lump Sum	N/A	\$
A.19	New North Bench Pump Station Structure, Complete	1 Lump Sum	N/A	\$
A.20	Furnish and Install North Bench Low Zone Pump and Motor Assemblies, Complete	2 Each	\$	\$
A.21	Furnish and Install North Bench High Zone Pump and Motor Assemblies, Complete	2 Each	\$	\$
A.22	Furnish and Install Ensign Downs Pump and Motor Assembly, Complete	1 Each	\$	\$
A.23	New North Bench Pump Station Internal Piping, Fittings, Complete	1 Lump Sum	N/A	\$
A.24	Furnish and Install 8-inch dia. Gate Valve	8 Each	\$	\$
A.25	Furnish and Install 10-inch dia. Gate Valve	2 Each	\$	\$
A.26	Furnish and Install 12-inch dia. Gate Valve	1 Each	\$	\$
A.27	Furnish and Install 10-inch dia. Butterfly Valve – Double Eccentric	2 Each	\$	\$
A.28	Furnish and Install 12-inch dia. Butterfly Valve – Double Eccentric	4 Each	\$	\$
A.29	Furnish and Install 16-inch dia. Butterfly Valve – Double Eccentric	1 Each	\$	\$
A.30	Furnish and Install 20-inch dia. Butterfly Valve – Double Eccentric	1 Each	\$	\$
A.31	Furnish and Install 8-inch dia. Swing Check Valve	4 Each	\$	\$
A.32	Furnish and Install 12-inch dia. Swing Check Valve	1 Each	\$	\$
A.33	Furnish and Install 8-inch dia. Magnetic Flowmeters	2 Each	\$	\$
A.34	Furnish and Install 12-inch dia. Magnetic Flowmeter	1 Each	\$	\$
A.35	Furnish and Install 8-inch dia. Pressure Reducing Valve (PRV)	1 Each	\$	\$

A.36	Furnish and Install 10-inch dia. Pressure Reducing Valve (PRV)	1 Each	\$	\$
A.37	New North Bench Pump Station HVAC System, Complete	1 Lump Sum	N/A	\$
A.38	New North Bench Pump Station Electrical and Instrumentation Systems, Complete	1 Lump Sum	N/A	\$
A.39	Pump Station Site Exterior Lighting	4 Each	\$	\$
A.40	Pump Station Interior Lighting	1 Lump Sum	N/A	
A.41	Pump Station Security System, Complete	1 Lump Sum	N/A	\$
A.42	Furnish and Install Workstation Crane	1 Lump Sum	N/A	\$
A.43	Furnish and Install Surge Tank- 500 Liter	2 Each	\$	\$
A.44	Furnish and Install 10-inch DIP PC350	1,485 Linear Feet	\$	\$
A.45	Furnish and Install 12-inch DIP PC350	175 Linear Feet	\$	\$
A.46	Furnish and Install 20-inch DIP PC250	600 Linear Feet	\$	\$
A.47	Construct Exterior Concrete Flatwork	1,050 Square Feet	\$	\$
A.48	Construct Thickened Concrete Generator Pad	155 Square Feet	\$	\$
A.49	Construct Asphalt Pump Station Access Road and Parking	20,150 Square Feet	\$	\$
A.50	Furnish and Install Ornamental Iron Fence	403 Linear Feet	\$	\$
A.51	Furnish and Install Ornamental Iron Access Gate (27-foot Wide)	1 Lump Sum	N/A	\$
A.52	Pump Station Landscaping and Site Restoration, Complete	1 Lump Sum	N/A	\$
A.53	Furnish and Install Storm Drain System, Drain Piping, and Drainage Structures	1 Lump Sum	N/A	\$
A.54	Furnish and Install New North Bench Pump Station Valve Pit Drain Pipeline	155 Linear Feet	\$	\$
A.55	Furnish and Install Connection to 10-inch Pumped Discharge Pressure Zones	2 Each	\$	\$
A.56	Furnish and Install CCWTP Pipeline Sta. 18+05.19 18-inch x 12-inch Tee Connection	1 Lump Sum	N/A	\$

A.57	Furnish and Install Air Valve Vault	2 Each	\$	\$
A.58	Decommission Existing North Bench Pump Station	1 Lump sum	N/A	\$
A.59	Improvements to Existing North Bench Pump Station	1 Lump Sum	N/A	\$
A.60	Slip-line Existing Sewer Lateral for Existing North Bench Pump Station	220 Linear Feet	\$	\$
A.61	Testing and Commissioning of New North Bench Pump Station and Control Valves	1 Lump Sum	N/A	\$

Total Bid Schedule A Amount = \$ \_\_\_\_\_

<p align="center"><b>Schedule B</b>  <b><u>VALVE VAULTS AND PIPELINE REPLACEMENT ALONG 18-INCH</u></b>  <b><u>CCWTP TRANSMISSION PIPELINE</u></b></p>				
Item	Specification Reference Number Classification of Work	Quantity and Unit	Unit Price	Total Cost
	<b>Water Services – Project No. 513416337</b>			
B.01	Mobilization/Demobilization	1 Lump Sum	N/A	\$
B.02	Construction Surveying	1 Lump Sum	N/A	\$
B.03	SWPPP	1 Lump Sum	N/A	\$
B.04	Materials Testing	1 Lump Sum	N/A	\$
B.05	Clearing, Grubbing, Stripping, and Erosion Control Measures	1 Lump Sum	N/A	\$
B.06	Traffic Control	1 Lump Sum	N/A	\$
B.07	Trail Management Including Signage and Temporary Relocation	1 Lump Sum	N/A	\$
B.08	Install Temporary Construction Fencing	1 Lump Sum	N/A	\$
B.09	General Allowance	1 Lump Sum	\$202,000	\$202,000
B.10	Special Permitting Allowance	1 Lump Sum	\$10,000	\$10,000
B.11	Furnish and Install 6-inch dia. Gate Valve	1 Each	\$	\$

B.12	Furnish and Install 10-inch dia. Gate Valve	2 Each	\$	\$
B.13	Furnish and Install 12-inch dia. Gate Valve	1 Each	\$	\$
B.14	Furnish and Install 18-inch dia. Butterfly Valve – Double Eccentric	4 Each	\$	\$
B.15	Furnish and Install 18-inch dia. Swing Check Valve	1 Each	\$	\$
B.16	Furnish and Install 18-inch dia. Magnetic Flowmeter	1 Each	\$	\$
B.17	Replace Existing 10-inch dia. Pressure Reducing Valve (PRV) Bypass with New 10-inch dia. PRV	1 Each	\$	\$
B.18	Furnish and Install 10-inch dia. Hydraulic Control Valve	1 Each	\$	\$
B.19	Furnish and Install 12-inch dia. Hydraulic Control Valve	1 Each	\$	\$
B.20	Furnish and Install 18-inch DIP PC250, CCWTP Transmission Pipeline Replacement (From Sta. 18+05.19 down to 18 <sup>th</sup> Ave., including Morris Outlet Pipeline)	611 Linear Feet	\$	\$
B.21	Furnish and Install 18-inch DIP CL53	35 Linear Feet	\$	\$
B.22	Hilltop Road Reconstruction	3,360 Square Feet	\$	\$
B.23	Modifications to Morris Reservoir Chain Link Fencing	1 Lump Sum	N/A	\$
B.24	Furnish and Install Morris Reservoir Inlet Vault, Piping, Pilot Connection, and Existing Vault Demolition	1 Lump Sum	N/A	\$
B.25	Furnish and Install Connection to Morris Reservoir Inlet	1 Lump Sum	N/A	\$
B.26	Morris Reservoir Inlet Vault Electrical and Instrumentation, Complete	1 Lump Sum	N/A	\$
B.27	Furnish and Install Morris Reservoir Outlet Vault and Piping	1 Lump Sum	N/A	\$
B.28	Furnish and Install Connection to Morris Reservoir Outlet	1 Lump Sum	N/A	\$
B.29	Morris Reservoir Outlet Vault Electrical and Instrumentation, Complete	1 Lump Sum	N/A	\$
B.30	Construct Morris Reservoir Outlet Vault Gravel Access Road	1,200 Square Feet	\$	\$

B.31	Furnish and Install Morris Reservoir Outlet Pipeline Connection to New 18-inch CCWTP Pipeline	1 Lump Sum	N/A	\$
B.32	Furnish and Install Air Vent on Suction Pipeline to top of Morris Reservoir at Morris Outlet Vault	1 Lump Sum	N/A	\$
B.33	Furnish and Install Ensign Downs Valve Vault, Piping, and Restoration, Complete	1 Lump Sum	N/A	\$
B.34	Ensign Downs Valve Vault Electrical and Instrumentation, Complete	1 Lump Sum	N/A	\$
B.35	Replace Hydraulic Control Valve with New 16-Inch Double-Eccentric Butterfly Valve in Ensign Downs Low Tank Vault	1 Lump Sum	N/A	\$
B.36	Testing and Commissioning of Schedule B New Pipeline and Control Valves	1 Lump Sum	N/A	\$

Total Bid Schedule B Amount = \$ \_\_\_\_\_

<p align="center"><b>Schedule C</b>  <b><u>18-INCH CCWTP TRANSMISSION PIPELINE – REPLACEMENT</u></b>  <b><u>ALTERNATIVE</u></b></p>				
<b>Item</b>	<b>Specification Reference Number Classification of Work</b>	<b>Quantity and Unit</b>	<b>Unit Price</b>	<b>Total Cost</b>
	<b>Water Services – Project No. 513416337</b>			
C.01	Furnish and Install 18-inch DIP PC250, CCWTP Transmission Pipeline Replacement (From High Point at Sta. 1+09.67 to Sta. 18+05.19)	1,696 Linear Feet	\$	\$
C.02	Furnish and Install 18-inch AVT EZ Insertion Isolation valve	1 Each	\$	\$
C.03	Furnish and Install Air Valve Vault	1 Each	\$	\$
C.04	Testing and Commissioning of New Pipeline	1 Lump Sum	N/A	\$

Total Bid Schedule C Amount = \$ \_\_\_\_\_

<p style="text-align: center;"><b>Schedule D</b>  <b><u>EXISTING 18-INCH CCWTP TRANSMISSION PIPELINE – LINER</u></b>  <b><u>ALTERNATIVE</u></b></p>				
<b>Item</b>	<b>Specification Reference Number Classification of Work</b>	<b>Quantity and Unit</b>	<b>Unit Price</b>	<b>Total Cost</b>
	<b>Water Services – Project No. 513416337</b>			
D.01	Furnish and Install Primus Liner in Existing 18-inch dia. CCWTP Transmission Pipeline (From High Point to 18-inch x 12-inch Tee at Sta. 18+05.19)	1,700 Linear Feet	\$	\$
D.02	Testing and Commissioning of Lined Pipe	1 Lump Sum	N/A	\$

Total Bid Schedule D Amount = \$ \_\_\_\_\_



## PART 3 MEASUREMENT AND PAYMENT

### 3.1 IN GENERAL

- A. See APWA Section 01 29 00 for general measurement and payment provisions.
- B. Specification sections referenced in price schedule line items give additional definitions to the classification of work.
- C. Incidental work or material will not be measured, counted or paid for separately.
- D. Backfilling demolition work depressions will not be measured or paid for separately except where structure or obstructions that are not designated for removal and disposal in the Bidding Documents, and that cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling, or blasting, will be paid for after adjusting the Contract Price by **Contract Modification** pricing.
- G. **Water and Storm Drain Work:**
  - 1. Unit prices cover the cost of furnishing labor, materials, products, tools, equipment, transportation, services and incidentals such as erection, application or installation of an item of work; overhead and profit, and all work shown on Drawings, defined in Specifications, and stipulated herein.
  - 2. Incidentals include progress schedule; mobilization and temporary facilities; project identification sign(s); traffic control; construction surveying; key hole excavations to locate utilities; installation of sewer manhole invert covers and subsequent removal; saw cutting and removal of existing trench pavement; unclassified excavation; trench dewatering; shoring or trench box, select import fill material; pipe zone and trench backfill per APWA Plans 381, 382 and Public Utilities Standard Practice No. 1; trench backfill compaction; removal and disposal of waste materials; monument restoration; road base; removal disposal, and replacement of concrete flatwork, landscape materials, and roadway pavements; repair of irrigation systems equal to or better than existing if damaged by the CONTRACTOR's operations; temporary asphalt concrete patch; and all other necessary work.
  - 3. Quality Compliance Program: Secure and provide backfill compliance compaction test results for ENGINEER's review. **Test results by an independent testing agency will be the only test results accepted.** The number of compliance tests required is 1 random density test per lift in each 200 feet of trench. An uncompacted backfill lift is 8" thick. Deficient number of required tests measured in percent will result in a pay reduction up to 25 percent of the Bid item requiring compacted backfill material.
  - 4. Over Excavation: No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.

3.2. **BID ITEM NO. A.01 & B.01 – MOBILIZATION/DEMOBILIZATION**

A. Measurement:

<b>Percent of Original Contract Amount Earned</b>	<b>Percent of Amount Bid for Mobilization to be Paid</b>
5	40
15	20
40	30
50	10

B. Includes preconstruction video, installation of temporary facilities, bringing all necessary construction equipment to site, risk, and incidentals such as coordination with and assisting utility companies while they do their utility work, miscellaneous probing for buried utilities public information dissemination, and demobilization.

3.3. **BID ITEM NO. A.02 & B.02 – CONSTRUCTION SURVEYING**

A. Includes CONTRACTOR construction staking and required survey control, submission of a certificate by a licensed land surveyor that horizontal and vertical survey control shown in the Contract Documents and in construction has been checked and verified.

B. Payment:

1. Paid as a percent complete when survey control and construction staking has been checked and verified.

3.4. **BID ITEM NO. A.03 & B.03 – SWPPP**

A. Measurement: Percent complete.

B. Payment:

1. 20 percent when Notice of Intent (NOI) has been published on EPA's website for at least 72 hours and a copy of the Storm Water Pollution Prevention Plan (SWPPP) has been submitted to ENGINEER.
2. 80 percent as work progresses.

3.5. **BID ITEM NO. A.04 & B.04 – MATERIALS TESTING**

A. "Materials Testing" is provided to cover the CONTRACTOR's cost for general and miscellaneous responsibilities and operations associated with Materials Testing. This item shall include, but not be limited to, work described or enumerated in Section 01 45 01 – Quality Control and Materials Testing (Supplement).

B. Measurement:

<b>Percent of Original Contract Amount Earned</b>	<b>Percent of Amount Bid for Materials Testing to be Paid</b>
10	25
25	25
50	25
75	25

- 3.6. **BID ITEM NO. A.05 & B.05 – CLEARING, GRUBBING, STRIPPING, AND EROSION CONTROL MEASURES**
- A. Includes incidentals such as setting line and grade stakes, clean area of brush, weeds, vegetation, grass, debris, and drain all depressions or ruts that contain water.
  - B. Payment
    - 1. Paid as a percentage complete of project required clearing, grubbing, stripping and erosion control measures.
- 3.7. **BID ITEM NO. A.06 & B.06 – TRAFFIC CONTROL**
- A. Includes incidentals such as police officer (as required), vehicular and pedestrian protection from work zone activity, services of a certified traffic control technician, and a traffic control plan acceptable to Salt Lake City's transportation engineer.
  - B. Payment
    - 1. Paid as a percentage complete of all traffic control measures required for the project.
- 3.8. **BID ITEM NO. A.07 & B.07 – TRAIL MANAGEMENT INCLUDING SIGNAGE AND TEMPORARY RELOCATION**
- A. Includes all work required for managing and maintaining local trails as shown on the Contract Drawings and Specifications not included in other bid items.
  - B. Payment
    - 1. Paid as a percent complete of trail management activities for the duration of the project, including signage and temporary relocations of trails.
- 3.9. **BID ITEM NO. A.08 & B.08 – INSTALL TEMPORARY CONSTRUCTION FENCING**
- A. Includes all work required for furnishing and installing temporary construction fencing within construction limits to maintain public safety and as required by CONTRACTOR.
  - B. Payment
    - 1. Paid as a percent complete of temporary construction fencing installed as shown.
- 3.10. **BID ITEM NO. A.09 – GENERAL ALLOWANCE**
- A. Measurement: To minimize delays and expedite the flow of work on the project, a maximum of **\$663,000** has been included in the Bid Schedule to compensate the CONTRACTOR for unspecified extra or additional Work that was not foreseeable at time of the bid, but that is necessary to complete the Project as originally contemplated. **An owner authorized General Allowance Work Order is required to obtain payment from the General Allowance.**
  - B. Payment Covers: See Article 10.4 in the Modifications to the General Conditions for additional information on the management, approval and payment for General Allowance Work Orders.
  - C. General Allowance funds that have not been disbursed at the completion of the project will be credited to the OWNER by the final reconciliation Change Order.
- 3.11. **BID ITEM NO. A.10 – SPECIAL PERMITTING ALLOWANCE**
- A. Measurement: A maximum of **\$25,000** has been included in the Bid Schedule to compensate the CONTRACTOR for this Specific Allowance which includes specified

items of Work generally known to be required for the Project but whose quantities and/or pricing is unknown until after the items of Work have been identified. **An owner authorized Specific Allowance Work Order is required to obtain payment from the defined Specific Allowance.**

- B. Payment Covers: The cost for acquiring permits required for performing the work included in Bid Schedule A.
- C. See Article 10.4 in the Modifications to the General Conditions for additional information on the management, approval and payment for Specific Allowance Work Orders.
- D. Specific Allowance funds that have not been disbursed at the completion of the project will be credited to the OWNER by the final reconciliation Change Order.

**3.12. BID ITEM NO. A.11 – ROCKY MOUNTAIN POWER ELECTRICAL POWER TRANSFORMER**

- A. Includes all work required to connect the site to Rocky Mountain Power service by excavating, furnishing and installing the required transformer vault with associated backfill and compaction, as shown on the Contract Drawings and RMP Work Order #007199239.
- B. Payment
  - 1. Paid as a percent completion of all required electrical power transformers furnished and installed.

**3.13. BID ITEM NO. A.12 – NOT USED**

**3.14. BID ITEM NO. A.13 – FURNISH AND INSTALL BURIED POWER CONDUITS**

- A. Measured in lineal feet along the buried power conduits alignment.
- B. Includes all labor and materials required for furnishing and installing all 4-inch buried power conduits, trench excavation, backfill and compaction from new power pole (installed by RMP) to new transformer and from new transformer to new pump station as shown on the Contract Drawings and RMP Work Order #007199239.
- C. Payment
  - 1. Paid per linear foot of buried power conduits furnished and installed.

**3.15. BID ITEM NO. A.14 – FURNISH AND INSTALL NATURAL GAS GENERATOR**

- A. Includes all work required for the installation of a complete and functional backup natural gas generator that automatically starts up and runs all required pumps and essential pump station electrical needs when power from the power grid fails, as required in the Contract Drawings and Specifications.
- B. Payment
  - 1. Paid as a lump sum when natural gas generator is furnished, installed, and tested.

**3.16. BID ITEM NO. A.15 – NATURAL GAS CONNECTION AND METER**

- A. Includes all labor and materials required to extend and coordinate (with Enbridge) the gas main to the natural gas service meter as shown in the Contract Drawings and Specifications.
- B. Payment

1. Paid as percent complete of labor and materials required to furnish and install natural gas service connection and meter.
- 3.17. **BID ITEM NO. A.16 – FURNISH AND INSTALL 2-INCH PE NATURAL GAS PIPELINE**
- A. Measured along the pipeline with no deduction for fittings. No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.
  - B. Includes all labor and materials required for furnishing and installing the 2-inch diameter natural gas pipeline from the gas meter to the pump station as shown in the Contract Drawings and Specifications.
  - C. Payment
    1. Paid per linear foot of 2-inch MDPE natural gas pipeline furnished, installed, and tested.
- 3.18. **BID ITEM NO. A.17 – SITE GRADING, BACKFILL, AND COMPACTION FOR NORTH BENCH PUMP STATION**
- A. Measured by the cubic yard of soil needed to complete the work.
  - B. Includes furnishing, installing, grading, and compacting the site, excluding the preparation of the surface for the access road as shown on the Contract Drawings and Specifications.
  - C. Payment
    1. Paid per the cubic yard of soil graded, placed, backfilled and compacted.
- 3.19. **BID ITEM NO. A.18 – EXCAVATION AND STRUCTURAL/FLOW FILL FOR NORTH BENCH PUMP STATION**
- A. Includes all work required for excavating and installing the structural/flow fill for the North Bench Pump Station as shown on the Contract Drawings and Specifications. See Sheet S-12 for assumed pump station excavation. Design assumed 5,000 cubic yards of excavation (see Note 3 on Sheet S-12).
  - B. Payment
    1. Paid as a percent complete for soils excavation and placement of structural or flowable fill as required for construction of the pump station.
- 3.20. **BID ITEM NO. A.19 – NEW NORTH BENCH PUMP STATION STRUCTURE, COMPLETE**
- A. Includes furnishing and constructing the structure for the pump house as required in the Contract Drawings and Specifications. Includes all items related to this work not paid elsewhere.
  - B. Payment
    1. Paid as a percent complete of the total pump station structure furnished, installed and constructed. The complete pump station structure includes concrete footings and concrete foundations, masonry walls, concrete slabs, concrete housekeeping pads, wood trusses and framing, architectural finishes, metal roofing system, doors and door hardware, floor and trench drains, stairs, handrails and working structural steel platforms.

- 3.21. **BID ITEM NO. A.20 – FURNISH AND INSTALL NORTH BENCH LOW ZONE PUMP AND MOTOR ASSEMBLIES, COMPLETE**
- A. Measured by each North Bench Low Zone pump and motor assemblies as shown on the Contract Drawings.
  - B. Includes all labor and materials required for furnishing, installing, and testing the pump and motor assemblies as shown on the Contract Drawings and specified herein.
  - C. Payment shall include furnishing and installing all pump cans, vertical turbine pumps with pump bowls, shafting and columns, motors, discharge heads, testing, startup, and all other pump related items not paid elsewhere as shown on the Contract Drawings and in the Specifications. Electrical gear and connections are paid elsewhere.
- 3.22. **BID ITEM NO. A.21 – FURNISH AND INSTALL NORTH BENCH HIGH ZONE PUMP AND MOTOR ASSEMBLIES, COMPLETE**
- A. Measured by each North Bench High Zone pump and motor assemblies as shown on the Contract Drawings.
  - B. Includes all labor and materials required for furnishing, installing, and testing the pump and motor assemblies as shown on the Contract Drawings and specified herein.
  - C. Payment shall include furnishing and installing all pump cans, vertical turbine pumps with pump bowls, shafting and columns, motors, discharge heads, testing, startup, and all other pump related items not paid elsewhere as shown on the Contract Drawings and in the Specifications. Electrical gear and connections are paid elsewhere.
- 3.23. **BID ITEM NO. A.22 – FURNISH AND INSTALL ENSIGN DOWNS PUMP AND MOTOR ASSEMBLY, COMPLETE**
- A. Measured by each Ensign Downs pump and motor assemblies as shown on the Contract Drawings.
  - B. Measurement includes all labor and materials required for furnishing, installing, and testing the Ensign Downs pump and motor assembly as shown on the Contract Drawings and specified herein.
  - C. Payment shall include furnishing and installing all pump cans, vertical turbine pump with pump bowl, shafting and column, motor, discharge head, testing, startup, and all other pump related items not paid elsewhere as shown on the Contract Drawings and in the Specifications. Electrical gear and connections are paid elsewhere.
- 3.24. **BID ITEM NO. A.23 – NEW NORTH BENCH PUMP STATION INTERNAL PIPING, FITTINGS, COMPLETE**
- A. Measurement includes all work required for furnishing, installing, and testing the pump house internal piping beginning at the first fitting outside the pump station footprint as shown on the Contract Drawings and specified herein.
  - B. Payment shall include all labor and materials required for furnishing, installing, and testing all piping and appurtenances (except as paid elsewhere), pipe supports, air valves, fittings, concrete encasements, couplings, ball valves, pressure gauges, sampling taps and all other items not paid elsewhere as shown on the Contract Drawings and in the Specifications.

- 3.25. **BID ITEM NO. A.24, A.25, & A.26 – FURNISH AND INSTALL 8-INCH DIA. GATE VALVE, 10-INCH DIA. GATE VALVE, 12-INCH DIA. GATE VALVE**
- A. Measured for each of the gate valves as shown on the Contract Drawings.
  - B. Payment includes furnishing, installing and testing each gate valve assembly installation and incidentals such as temporary supports nuts, bolts, gaskets, and connection to existing or new pipe.
- 3.26. **BID ITEM NO. A.27, A.28, A.29, & A.30 – FURNISH AND INSTALL 10-INCH DIA. BUTTERFLY VALVE – DOUBLE ECCENTRIC, 12-INCH DIA. BUTTERFLY VALVE – DOUBLE ECCENTRIC, 16-INCH DIA. BUTTERFLY VALVE – DOUBLE ECCENTRIC, 20-INCH DIA. BUTTERFLY VALVE – DOUBLE ECCENTRIC**
- A. Measured for each of the butterfly valves a shown on the Contract Drawings.
  - B. Payment includes furnishing, installing and testing each butterfly valve assembly installation and incidentals such as temporary supports nuts, bolts, gaskets, and connection to existing or new pipe.
- 3.27. **BID ITEM NO. A.31 & A.32 – FURNISH AND INSTALL 8-INCH DIA. SWING CHECK VALVE, 12-INCH DIA. SWING CHECK VALVE**
- A. Measured for each of the swing check valves as shown on the Contract Drawings.
  - B. Payment includes furnishing, installing and testing each check valve assembly installation and incidentals such as temporary supports; nuts, bolts, gaskets, and connection to existing or new pipe.
- 3.28. **BID ITEM NO. A.33 & A.34 – FURNISH AND INSTALL 8-INCH DIA. MAGNETIC FLOWMETERS, 12-INCH DIA. MAGNETIC FLOWMETER**
- A. Measured for each magnetic flow meter as shown on the Contract Drawings.
  - B. Payment includes furnishing, installing and testing each flowmeter assembly installation and incidentals such as temporary supports; nuts, bolts, gaskets, and connection to existing or new pipe.
- 3.29. **BID ITEM NO. A.35 & A.36 – FURNISH AND INSTALL 8-INCH DIA. PRESSURE REDUCING VALVE (PRV), 10-INCH DIA. PRESSURE REDUCING VALVE (PRV)**
- A. Measured for each pressure reducing valve (PRV) as shown on the Contract Drawings.
  - B. Payment includes furnishing, installing and testing each PRV assembly installation and incidentals such as temporary supports; nuts, bolts, gaskets, and connection to existing or new pipe.
- 3.30. **BID ITEM NO. A.37 – NEW NORTH BENCH PUMP STATION HVAC SYSTEM, COMPLETE**
- A. Measured to include all labor and materials required for the construction and installation of HVAC systems as noted, including all components required on the Contract Drawings and in the Specifications.
  - B. Payment shall include, but not be limited to, all labor, materials, and equipment for furnishing, installing, and testing all HVAC equipment, including but not limited to, wire and conduit per Division 26, instrumentation, air handling units with exterior mounted condensing units, electric unit heaters, ductwork, exhaust fans, exhaust fan hoods,

supports, louvers, and all other related items as shown on the Contract Drawings not paid elsewhere for a complete and operable HVAC system.

**3.31. BID ITEM NO. A.38 – NEW NORTH BENCH PUMP STATION ELECTRICAL AND INSTRUMENTATION SYSTEM, COMPLETE**

- A. Measured to include all labor and materials required for furnishing and installing all electrical equipment not paid for elsewhere according to the amount defined in the Bid Schedule and as completed by CONTRACTOR.
- B. Payment for “Electrical System Complete” shall be made at the contract lump sum bid price for completion of all electrical work as shown on the Contract Drawings and specified herein. Payment shall include, but not be limited to, all labor, materials, and equipment for furnishing and installing all electrical service at the pump station, panelboards, VFDs, transformers, service outlets, pressure switches, pressure transducers, intrusion switches, flood switch, above-grade and buried conduits, electrical service connection, wiring for equipment controls and signals, grounding, antenna, pump motor terminators (motors are furnished and installed under Bid Items A.20, A.21, and A.22), lightning protection system, connections to water quality monitoring equipment, HVAC, and all other items as shown on the Contract Drawings required for a complete and operable electrical system.

**3.32. BID ITEM NO. A.39 – PUMP STATION SITE EXTERIOR LIGHTING**

- A. Measured for each exterior lighting assemblies as shown on the Contract Drawings.
- B. Payment includes all labor and materials required for furnishing, installing, and testing exterior lighting on the outside of the pump station as shown on the Contract Drawings and Specifications.

**3.33. BID ITEM NO. A.40 – PUMP STATION INTERIOR LIGHTING**

- A. Measured for all of the specified interior lighting as shown on the Contract Drawings.
- B. Payment includes all labor and materials required for furnishing, installing, and testing the interior lighting for the pump station as shown on the Contract Drawings and Specifications.

**3.34. BID ITEM NO. A.41 – PUMP STATION SECURITY SYSTEM, COMPLETE**

- A. Measured for the complete pump station security system as shown on the Contract Drawings.
- B. Payment includes all labor and materials required for furnishing, installing, and testing the complete security system as shown on the Contract Drawings and Specifications.

**3.35. BID ITEM NO. A.42 – FURNISH AND INSTALL WORKSTATION CRANE**

- A. Measured for the specified workstation crane system complete, and as shown on the Contract Drawings.
- B. Payment includes all labor and materials required to acquire, transport, install and test the workstation crane to the project location for installation.



**3.36. BID ITEM NO. A.43 – FURNISH AND INSTALL SURGE TANK – 500 LITER**

- A. Measured for each surge tank as shown in the Contract Drawings. Includes all work for complete installation of each surge tank and accompanying facilities as shown on the Contract Drawings and Specifications.
- B. Payment shall include all labor, materials, and equipment required for furnishing, installing, and testing each bladder type surge tank, appurtenances, and all water piping, valves, couplings, fittings, pressure monitoring devices, pressure relief valves; conduits, supports, and all other related items and appurtenances for a complete bladder type surge tank system; including cleaning, air and water filling, calibration, disinfection, and testing of tanks and all instruments in accordance with Manufacturer recommendations, complete, and as shown in Contract Drawings and Specifications.

**3.37. BID ITEM NO. A.44, A.45, &A.46 – FURNISH AND INSTALL 10-INCH DIP PC350, 12-INCH DIP PC350, 20-INCH DIP PC250**

- A. Measured along the pipeline with no deduction for fittings or manholes starting after the first fitting outside the pump station footprint. No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.
- B. Payment includes labor and materials shown in APWA Plan 381, 382 and Public Utilities Department Standard Practice No. 1, as shown on Sheets PP-1 through PP-8, and incidentals such as excavation, removing interfering structures and obstructions, groundwater control, shoring and bracing, pipe, gaskets, bolts and nuts, tees, bends, sleeves, transition couplings and reducers, plugs, caps, blowoffs, drains, air valves or related appurtenances, washout valve assemblies, joint restraining devices, fittings, connections, wax primer, tape, and plastic wrapper on all fittings, bolts and nuts that receive direct burial, sewer pipeline repair if disturbed by construction operations, abandonment of the existing water pipe(s), fittings and structures, pipe zone and trench backfill and compaction, temporary roadway or sidewalk surfacing materials, cleaning, flushing, testing, disinfecting and commissioning.

**3.38. BID ITEM NO. A.47 – CONSTRUCT EXTERIOR CONCRETE FLATWORK**

- A. Measured by the square foot for the construction of all concrete sidewalks and ramps as shown on the Contract Drawings and specifications not covered in other bid items.
- B. Payment includes all labor and materials required for furnishing and installing all exterior concrete sidewalks and ramps as shown on the Contract Drawings and Specifications not covered in other bid items.

**3.39. BID ITEM NO. A.48 – CONSTRUCT THICKENED CONCRETE GENERATOR PAD**

- A. Measured by the square foot for the construction of the thickened concrete backup generator pad as shown on the Contract Drawings and specifications.
- B. Payment includes all labor and materials required for furnishing and installing the thickened concrete backup generator pad with all appurtenant structural reinforcing steel and as shown on the Contract Drawings and Specifications.

**3.40. BID ITEM NO. A.49 – CONSTRUCT ASPHALT PUMP STATION ACCESS ROAD AND PARKING**

- A. Measured by the square foot for construction of the access road as shown on the Contract Drawings.
  - B. Payment shall include, but not be limited to all labor, equipment and materials necessary for excavation, grading, imported road base, compaction, removal and on-site disposal of excess excavated material, asphalt placement and testing; restoration of all surface improvements; and all other operations and materials required to complete the work as herein described and as shown on the Contract Drawings.
- 3.41. **BID ITEM NO. A.50 – FURNISH AND INSTALL ORNAMENTAL IRON FENCE**
- A. Measured parallel to ground surface for each foot of ornamental iron fence furnished and installed. Openings for gates are not measured in this quantity.
  - B. Payment includes all labor and materials as shown in the Contract Drawings and Specifications and incidentals such as excavating high points, truss rods and braces, concrete, connecting new fences to structures and existing fences, caps, couplings, fittings and hardware, support or extension arm if any, and any appurtenances required for a functional and secure wrought iron fence around the new pump station.
- 3.42. **BID ITEM NO. A.51 – FURNISH AND INSTALL ORNAMENTAL IRON ACCESS GATE (27-FEET WIDE)**
- A. Measured for a single wrought iron access gate furnished and installed.
  - B. Payment includes labor and materials required as shown in the Contract Drawings and Specifications and incidentals such as clearing and disposal, excavating high points, truss rods and braces, concrete, connecting new fences to structures and existing fences, caps, couplings, fittings and hardware, support or extension arm if any, and connection of SLCDPU electronic access security system and electrical power to operate said system.
- 3.43. **BID ITEM NO. A.52 – PUMP STATION LANDSCAPING AND SITE RESTORATION, COMPLETE**
- A. Measured to include all landscaping within the boundary of the ornamental iron fencing as per the Contract Drawings and Specifications, and restoration of all disturbed area outside of the ornamental iron fence in accordance with Contract Drawings and Specifications.
  - B. Payment includes all labor and materials required for completing the landscaping and site restoration for the new North Bench Pump Station as shown on the Contract Drawings and Specifications not covered in other bid items.
- 3.44. **BID ITEM NO. A.53 – FURNISH AND INSTALL STORM DRAIN SYSTEM, DRAIN PIPING, AND DRAINAGE STRUCTURES**
- A. Measured by the complete storm drainage system furnished and installed as shown on the Contract Drawings.
  - B. Payment includes all labor and materials required for furnishing and installing the storm drain system (shown on Sheet PP-9), floor drain piping within the pump station footprint, and drainage structures as shown on the Contract Drawings and Specifications not covered in other bid items.
- 3.45. **BID ITEM NO. A.54 – FURNISH AND INSTALL NEW NORTH BENCH PUMP STATION VALVE PIT DRAIN PIPELINE**

- A. Measured along the pipe with no deduction for fittings or manholes. No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.
  - B. Payment includes all labor and materials necessary to furnish and install the valve pit drain pipeline shown on Sheet PP-10 and outfall structure (detail 3 on Sheet C-25), connection to floor drains and outfall structure as shown on the Contract Drawings.
- 3.46. **BID ITEM NO. A.55 – FURNISH AND INSTALL CONNECTION TO 10-INCH PUMPED DISCHARGE PRESSURE ZONES**
- A. Measured to include all piping and appurtenances required to make each connection to the existing SLC water distribution system at the locations shown on the Contract Drawings beginning after the first fitting outside the pump station footprint.
  - B. Payment includes all labor and materials, including piping, valves, fittings, or related appurtenances, flushing, and disinfection required for connecting each pumped discharge connections from the new North Bench Pump Station as shown in the Contract Drawings (detail 2 on Sheet C-23 and Sheet C-25) and Specifications.
- 3.47. **BID ITEM NO. A.56 – FURNISH AND INSTALL CCWTP PIPELINE STA. 18+05.19 18-INCH X 12-INCH TEE CONNECTION**
- A. Measured to include furnishing and installing an 18-inch x 12-inch Ductile Iron Tee as shown on the Contract Drawings.
  - B. Payment includes all labor and materials required for furnishing, installing, connecting, flushing, testing and disinfecting the 18-inch x 12-inch tee connection on the new 18-inch CCWTP pipeline at STA 18+05.19 as shown on the Contract Drawings and Specifications.
- 3.48. **BID ITEM NO. A.57 – FURNISH AND INSTALL AIR VALVE VAULT**
- A. Measured for each air valve vault as shown on the Contract Drawings.
  - B. Payment includes all labor and materials required for furnishing and installing all components including air valve, piping, precast concrete structure, manhole ring and cover, excavation, compaction, backfill, flushing, testing and disinfecting each of the air valve vaults as shown on the Contract Drawings and Specifications.
- 3.49. **BID ITEM NO. A.58 – DECOMMISSION EXISTING NORTH BENCH PUMP STATION**
- A. Measured to include all necessary decommissioning activities of the existing North Bench Pump Station, only after the new North Bench Pump Station is fully operational.
  - B. Payment includes all labor and materials required for the decommissioning of the existing North Bench Pump Station, including demolition and removal of the existing pumps and piping, demolition of the floor area under the existing pumps as per the Contract Drawings, demolition and removal of electrical panels and pump control systems, including existing lighting and electrical wiring, demolition and removal of existing windows, demolition and removal of bathroom fixtures and existing plumbing, and other related demolition work as shown on the Contract Drawings and Specifications. **Existing SCADA panel and existing electrical resistance heater to be salvaged for future use.**
- 3.50. **BID ITEM NO. A.59 – IMPROVEMENTS TO EXISTING NORTH BENCH PUMP STATION**

- A. Measured to include all renovation and remodel (improvements) work to the existing pump station as shown on the Contract Drawings.
  - B. Payment includes all labor and materials required for completing the improvements to the Existing North Bench Pump Station, including replacement of removed concrete slab, new aluminum windows and bathroom fixtures and incidental plumbing, connection to slip-lined sewer lateral, new interior painting and coatings, new interior lighting, electrical wiring and switches, new space heater in bathroom area, modifications to bathroom interior walls and replacing access door, and other improvements as shown on the Contract Drawings and Specifications.
- 3.51. **BID ITEM NO. A.60 – SLIP-LINE EXISTING SEWER LATERAL FOR EXISTING NORTH BENCH PUMP STATION**
- A. Measured along the existing with sewer lateral with no deductions for fittings or manholes. No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.
  - B. Payment shall include all labor and materials necessary to video the sewer lateral before and after liner installation, install a liner in the existing 4-inch dia. sewer lateral that serves the existing pump station and connects to the sanitary sewer collection system in 18<sup>th</sup> Ave, and testing to confirm the lateral is returned to proper working condition.
- 3.52. **BID ITEM NO. A.61 – TESTING AND COMMISSIONING OF NEW NORTH BENCH PUMP STATION AND CONTROL VALVES**
- A. Measured to include all labor required for testing and commissioning the completed pump station and the components therein.
  - B. Payment shall include, but not be limited to, all labor, equipment, and materials required for all work performed. Testing shall include, but not be limited to, verifying all components are working in accordance with the Contract Drawings and Specifications, testing/confirming pump flow and head, shutoff switches are set and operating properly, pressure transmitters are calibrating and operating correctly, flow meters are calibrating and operating correctly, surge tanks are operating correctly, and verifying all subsystems are in working condition, verifying that the pump motors are wired in the correct direction, and verifying all circuits and panels are wired correctly.

## **SCHEDULE B**

3.53. **BID ITEM NO. B.09 – GENERAL ALLOWANCE**

- A. Measurement: To minimize delays and expedite the flow of work on the project, a maximum of **\$202,000** has been included in the Bid Schedule to compensate the CONTRACTOR for unspecified extra or additional Work that was not foreseeable at time of the bid, but that is necessary to complete the Project as originally contemplated. **An owner authorized General Allowance Work Order is required to obtain payment from the General Allowance.**
- B. Payment Covers: See Article 10.4 in the Modifications to the General Conditions for additional information on the management, approval and payment for General Allowance Work Orders.

- C. General Allowance funds that have not been disbursed at the completion of the project will be credited to the OWNER by the final reconciliation Change Order.

**3.54. BID ITEM NO. B.10 – SPECIAL PERMITTING ALLOWANCE**

- A. Measurement: A maximum of **\$10,000** has been included in the Bid Schedule to compensate the CONTRACTOR for this Specific Allowance which includes specified items of Work generally known to be required for the Project but whose quantities and/or pricing is unknown until after the items of Work have been identified. **An owner authorized Specific Allowance Work Order is required to obtain payment from the defined Specific Allowance.**
- B. Payment Covers The cost for acquiring permits required for performing the work included in Bid Schedule B.
- C. See Article 10.4 in the Modifications to the General Conditions for additional information on the management, approval and payment for Specific Allowance Work Orders.
- D. Specific Allowance funds that have not been disbursed at the completion of the project will be credited to the OWNER by the final reconciliation Change Order.

**3.55. BID ITEM NO. B.11, B.12, & B.13 – FURNISH AND INSTALL 6-INCH DIA. GATE VALVE, 10-INCH DIA GATE VALVE, 12-INCH DIA. GATE VALVE**

- A. Measured for each buried gate valve furnished and installed as shown on the Contract Drawings.
- B. Payment includes all labor and materials required for each gate valve assembly installation and incidentals such as excavation; removing interfering structures and obstructions; groundwater control; shoring and bracing; nuts, bolts, gaskets, wax primer, tape, and plastic wrapper on all fittings, bolts and nuts that receive direct burial; pipe zone and trench backfill and compaction; connection to existing or new pipe; 2 piece slip type cast iron valve box; adjustment of valve box lid to final grade with a roadway cover collar shown in APWA Plan 574.

**3.56. BID ITEM NO. B.14 – FURNISH AND INSTALL 18-INCH DIA BUTTERFLY VALVE – DOUBLE ECCENTRIC**

- A. Measured for each of the butterfly valves as shown on the Contract Drawings.
- B. Payment includes all labor and materials required for each butterfly valve assembly installation and incidentals such as excavation; removing interfering structures and obstructions; groundwater control; shoring and bracing; nuts, bolts, gaskets, wax primer, tape, and plastic wrapper on all fittings, bolts and nuts that receive direct burial; pipe zone and trench backfill and compaction; connection to existing or new pipe; 2 piece slip type cast iron valve box; adjustment of valve box lid to final grade with a roadway cover collar shown in APWA Plan 574.

**3.57. BID ITEM NO. B.15 – FURNISH AND INSTALL 18-INCH DIA. SWING CHECK VALVE**

- A. Measured for each swing check valve assembly furnished and installed.
- B. Payment includes all labor and materials required for each swing check valve assembly installation and incidentals such as excavation; removing interfering structures and obstructions; groundwater control; shoring and bracing; nuts, bolts, gaskets, wax primer, tape, and plastic wrapper on all fittings, bolts and nuts that receive direct burial; pipe zone and trench backfill and compaction; connection to existing or new pipe; 2 piece slip type

cast iron valve box; adjustment of valve box lid to final grade with a roadway cover collar shown in APWA Plan 574.

**3.58. BID ITEM NO. B.16 – FURNISH AND INSTALL 18-INCH DIA. MAGNETIC FLOWMETER**

- A. Measured for each 18-inch dia. magnetic flowmeter furnished and installed.
- B. Payment includes all labor and materials required for furnishing, installing and testing each magnetic flowmeter installation and incidentals such as temporary supports; nuts, bolts, gaskets, and connection to existing or new pipe.

**3.59. BID ITEM NO. B.17 – REPLACE EXISTING 10-INCH DIA. PRESSURE REDUCING VALVE (PRV) BYPASS WITH NEW 10-INCH DIA. PRV**

- A. Measured to include each replacement 10-inch dia. pressure reducing bypass valve.
- B. Payment includes all labor and materials required for furnishing and installing the pressure reducing bypass valve for the 10-inch ductile iron piping as shown on the Contract Drawings and Specifications.

**3.60. BID ITEM NO. B.18 & B.19 – FURNISH AND INSTALL 10-INCH DIA. HYDRAULIC CONTROL VALVE, 12-INCH DIA. HYDRAULIC CONTROL VALVE**

- A. Measured for each of the hydraulic control valves furnished and installed as shown on the Contract Drawings.
- B. Payment includes all labor and materials required for furnishing, installing and testing each hydraulic control valve installation and incidentals such as temporary supports; nuts, bolts, gaskets, and connection to existing or new pipe.

**3.61. BID ITEM NO. B.20 – FURNISH AND INSTALL 18-INCH DIP PC250, CCWTP TRANSMISSION PIPELINE REPLACEMENT (FROM STA. 18+05.19 DOWN TO 18<sup>TH</sup> AVE., INCLUDING MORRIS OUTLET PIPELINE)**

- A. Measured along the pipeline with no deduction for fittings or manholes. No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.
- B. Payment includes all labor and materials shown in APWA Plan 381, 382 and Public Utilities Department Standard Practice No. 1, and incidentals such as excavation, removing interfering structures and obstructions, groundwater control, shoring and bracing, pipe, gaskets, bolts and nuts, tees, bends, sleeves, transition couplings and reducers, plugs, caps, washout valve assemblies, joint restraining devices, fittings, connections, wax primer, tape, and plastic wrapper on all fittings, bolts and nuts that receive direct burial, sewer pipeline repair if disturbed by construction operations, abandonment of the existing water pipe(s), fittings and structures, pipe zone and trench backfill and compaction, temporary roadway or sidewalk surfacing materials, cleaning and commissioning, flushing, testing and disinfecting.
- C. Payment includes the roadway pavement structural section composed of crushed aggregate base and asphalt concrete as shown in APWA Plan 255 or Portland cement concrete as shown in APWA Plan 256. Also included are all labor and materials as shown on the Contract Drawings required for the replacement of the existing 18-inch pipeline, connection of new pipeline, and all other items not covered in other bid items.

**3.62. BID ITEM NO. B.21 – FURNISH AND INSTALL 18-INCH DIP CL53**

- A. Measured along the pipeline with no deduction for fittings or manholes. 18-inch DIP within vaults extending to first fitting or sleeve outside of the vault. Vaults including but not limited to: the air valve at the high point, Morris Reservoir inlet and outlet vaults, and vaults within Hilltop Road with new 18-inch DIP.
- B. Payment includes are all labor and materials as shown on the Contract Drawings required for furnishing and installing all 18-inch DIP Class 53 inside new or existing vaults including but not limited to: labor and materials for temporary piping supports, pipe, gaskets, bolts and nuts, sleeves, transition couplings and reducers, plugs, caps, washout valve assemblies, joint restraining devices, fittings, connections, wax primer, tape, and plastic wrapper on all fittings outside of vaults, cleaning, flushing, testing and disinfection, and all other items not covered in other bid items.

**3.63. BID ITEM NO. B.22 – HILLTOP ROAD RECONSTRUCTION**

- A. Measured by the square foot for reconstruction of Hilltop Road as shown on the Contract Drawings.
- B. Payment shall include, but not be limited to, all labor, equipment, materials necessary for excavation, imported road base and asphalt, compaction, removal and on-site disposal of excess excavated material, testing; restoration of all surface improvements; and all other operations and materials required to complete the work as herein described and as shown on the Contract Drawings.

**3.64. BID ITEM NO. B.23 – MODIFICATIONS TO MORRIS RESERVOIR CHAIN LINK FENCING**

- A. Measured by the lump sum modifications and restoration of the chain link fencing surrounding Morris Reservoir.
- B. Payment includes all labor and materials required for furnishing and installing the modifications to the Morris Reservoir chain link fencing as shown on the Contract Drawings and Specifications.

**3.65. BID ITEM NO. B.24 – FURNISH AND INSTALL MORRIS RESERVOIR INLET VAULT, PIPING, PILOT CONNECTION, AND EXISTING VAULT DEMOLITION**

- A. Measured by lump sum unit cost to furnish and install Morris Reservoir Inlet Vault, piping and appurtenances.
- B. Payment for furnishing and installing all components included in the new Morris Reservoir Inlet Valve Vault, including the concrete vault, access hatch, fittings and appurtenances, control valve, pilot connection and required phased demolition of the existing vault, and as shown on the Contract Drawings and Specifications. Payment for all labor and materials required including, but not limited to: requirements shown in APWA Plan 381, 382 and Public Utilities Department Standard Practice No. 1, and incidentals such as excavation, removing interfering structures and obstructions, groundwater control, shoring and bracing, piping not covered in other bid items, gaskets, bolts and nuts, tees, bends, sleeves, transition couplings and reducers, plugs, caps, washout valve assemblies, joint restraining devices, fittings, connections, wax primer, tape, and plastic wrapper on all fittings outside of vaults, bolts and nuts that receive direct burial, sewer pipeline repair if disturbed by construction operations, abandonment of the existing water pipe(s), fittings and structures,

pipe zone and trench backfill and compaction, temporary roadway or sidewalk surfacing materials, cleaning and commissioning, flushing, testing and disinfection.

**3.66. BID ITEM NO. B.25 – FURNISH AND INSTALL CONNECTION TO MORRIS RESERVOIR INLET**

- A. Measured to include all labor and materials necessary to connect the new 18-inch CCWTP transmission pipeline to the new Morris Reservoir Inlet Vault.
- B. Payment includes all labor and materials required for connecting the new 18-inch CCWTP pipeline to the new Morris Reservoir Inlet Valve Vault, including all necessary flushing, testing and disinfection as shown on the Contract Drawings and Specifications not covered in other bid items.

**3.67. BID ITEM NO. B.26 – MORRIS RESERVOIR INLET VAULT ELECTRICAL AND INSTRUMENTATION, COMPLETE**

- A. Measured to include electrical and instrumentation functions that are required for the Morris Reservoir Inlet Vault.
- B. Payment includes all labor and materials required for furnishing and installing the electrical components, electrical power service, and instrumentation for the new Morris Reservoir Inlet Valve Vault so that the inlet vault is fully functional as shown on the Contract Drawings and Specifications.

**3.68. BID ITEM NO. B.27 – FURNISH AND INSTALL MORRIS RESERVOIR OUTLET VAULT AND PIPING**

- A. Measured by lump sum unit cost to furnish and install Morris Reservoir Outlet Vault, piping and appurtenances.
- B. Payment for furnishing and installing the Morris Reservoir outlet vault including the concrete structure, all fittings, valves and appurtenances and access hatch as shown on the Contract Drawings and Specifications. Payment for all labor and materials required including, but not limited to: requirements shown in APWA Plan 381, 382 and Public Utilities Department Standard Practice No. 1, and incidentals such as excavation, removing interfering structures and obstructions, groundwater control, shoring and bracing, piping not covered in other bid items, gaskets, bolts and nuts, tees, bends, sleeves, transition couplings and reducers, plugs, caps, washout valve assemblies, joint restraining devices, fittings, connections, wax primer, tape, and plastic wrapper on all fittings outside of vaults, bolts and nuts that receive direct burial, sewer pipeline repair if disturbed by construction operations, abandonment of the existing water pipe(s), fittings and structures, pipe zone and trench backfill and compaction, temporary roadway or sidewalk surfacing materials, cleaning and commissioning, flushing, testing and disinfection.

**3.69. BID ITEM NO. B.28 – FURNISH AND INSTALL CONNECTION TO MORRIS RESERVOIR OUTLET**

- A. Measured to include all labor and materials necessary to connect the Morris Reservoir Outlet Vault to the new 20-inch pump station intake pipeline.
- B. Payment includes all labor and materials required to connect the 20-inch intake pipeline for the new North Bench Pump Station to the existing Morris Reservoir Outlet Valve Vault as shown on the Contract Drawings and Specifications.



- 3.70. **BID ITEM NO. B.29 – MORRIS RESERVOIR OUTLET VAULT ELECTRICAL AND INSTRUMENTATION, COMPLETE**
- A. Measured to include electrical and instrumentation functions that are required for the Morris Reservoir Outlet Vault.
  - B. Payment includes all labor and materials required for furnishing and installing the electrical power services and instrumentation components of the Morris Reservoir Outlet Valve Vault as shown on the Contract Drawings and Specifications.
- 3.71. **BID ITEM NO. B.30 – CONSTRUCT MORRIS RESERVOIR OUTLET VAULT GRAVEL ACCESS ROAD**
- A. Measured by the square foot for construction of the Morris Reservoir Outlet Vault Gravel Access Road as shown on the Contract Drawings.
  - B. Payment shall include, but not be limited to, all labor, equipment, materials necessary for excavation, imported road base, compaction, removal and on-site disposal of excess excavated material, testing; restoration of all surface improvements; and all other operations and materials required to complete the work as herein described and as shown on the Contract Drawings.
- 3.72. **BID ITEM NO. B.31 – FURNISH AND INSTALL MORRIS RESERVOIR OUTLET PIPELINE CONNECTION TO NEW 18-INCH CCWTP PIPELINE**
- A. Measured as a lump sum to include all new 18-inch Ductile Iron pipe to connect the Morris Reservoir Outlet Vault to the new 18-inch CCWTP transmission pipeline as per the Contract Drawings.
  - B. Payment includes all labor and materials required for furnishing, installing, and connecting the new 18-inch CCWTP pipeline to the existing Morris Reservoir Outlet Pipeline, including all required piping, fittings, valves and appurtenances, excavation, compaction, flushing, testing and disinfection as shown on the Contract Drawings and Specifications.
- 3.73. **BID ITEM NO. B.32 – FURNISH AND INSTALL AIR VENT ON SUCTION PIPELINE TO TOP OF MORRIS RESERVOIR AT MORRIS OUTLET VAULT**
- A. Measured to include the air release valve and all related piping and appurtenances to construct an air vent on the pump station suction intake as per the Contract Drawings.
  - B. Payment includes all labor and materials required for furnishing and installing the air vent on the suction pipeline connecting to the Morris Reservoir Outlet Vault, including the air valve, piping, fittings, valves, flushing, testing and disinfection as shown on the Contract Drawings and Specifications.
- 3.74. **BID ITEM NO. B.33 – FURNISH AND INSTALL ENSIGN DOWNS VALVE VAULT, PIPING, AND RESTORATION, COMPLETE**
- A. Measured by lump sum unit cost to furnish and install Ensign Downs Valve Vault, piping and appurtenances in accordance with the Contract Drawings.
  - B. Payment includes all labor and materials required for furnishing and installing all components included in the Ensign Downs Vault, including hydraulic control valve, piping, fittings, valves and appurtenances, concrete vault, excavation, compaction, backfill, finish grading, restoration of surface landscaping, connections to existing

distribution system, flushing, testing and disinfection, as shown on the Contract Drawing and Specifications.

**3.75. BID ITEM NO. B.34 – ENSIGN DOWNS VALVE VAULT ELECTRICAL AND INSTRUMENTATION, COMPLETE**

- A. Measured to include electrical and instrumentation functions that are required for the Ensign Downs Valve Vault.
- B. Payment includes all labor and materials required for installing the electrical power service and instrumentation components of the Ensign Downs Valve Vault as shown on the Contract Drawings and Specifications.

**3.76. BID ITEM NO. B.35 – REPLACE HYDRAULIC CONTROL VALVE WITH NEW 16-INCH DOUBLE-ECCENTRIC BUTTERFLY VALVE IN ENSIGN DOWNS LOW TANK VAULT**

- A. Measured by lump sum for the replacement of a single hydraulic control valve adjacent to the Ensign Downs Low Tank with a new butterfly, isolation valve.
- B. Payment includes all labor and materials required for furnishing and replacing the existing hydraulic control valve with a new double-eccentric 16-inch butterfly valve and required fittings, flushing, testing and disinfection as shown on the Contract Drawings and Specifications.

**3.77. BID ITEM NO. B.36 – TESTING AND COMMISSIONING OF SCHEDULE B NEW PIPELINE AND CONTROL VALVES**

- A. Measured to include all testing and commissioning of new pipeline and control valves within Schedule B.
- B. Payment includes all labor and materials required for testing the completed pipeline, control valves, and the components therein. Payment shall include, but not be limited to, all labor, equipment, and materials required for all work performed. Testing shall include, but not be limited to, verifying all components are working in accordance with the Contract Drawings and Specifications, verifying all subsystems (including electrical and instrumentation) are in full operational condition and that all piping and control valves have been flushed, pressure-tested and disinfected.

**SCHEDULE C**

**3.78. BID ITEM NO. C.01 – FURNISH AND INSTALL 18-INCH DIP PC250, CCWTP TRANSMISSION PIPELINE REPLACEMENT (FROM HIGH POINT AT STA. 1+09.67 TO STA 18+05.19)**

- A. Measured along the pipeline with no deduction for fittings or manholes. No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.
- B. Payment includes labor and materials shown in APWA Plan 381, 382 and Public Utilities Department Standard Practice No. 1, and incidentals such as excavation, removing interfering structures and obstructions, groundwater control, shoring and bracing, pipe, gaskets, bolts and nuts, tees, bends, sleeves, transition couplings and reducers, plugs, caps, washout valve assemblies, joint restraining devices, fittings, connections, wax primer, tape, and plastic wrapper on all fittings, bolts and nuts that receive direct burial, sewer pipeline

repair if disturbed by construction operations, abandonment of the existing water pipe(s), fittings and structures, pipe zone and trench backfill and compaction, temporary roadway or sidewalk surfacing materials, cleaning and commissioning, flushing, testing and disinfection.

- C. Payment also includes, and all labor and materials as shown on the Contract Drawings required for the replacement of the existing 18-inch pipeline, connection of new pipeline, and all other items not covered in other bid items.

**3.79. BID ITEM NO. C.02 – FURNISH AND INSTALL 18-INCH AVT EZ INSERTION ISOLATION VALVE**

- A. Measured as a lump sum for a single AVT EZ Insertion Isolation Valve furnished and installed as shown on the Contract Drawings.
- B. Payment includes all labor and materials required for furnishing and installing an AVT EZ Insertion Isolation valve, including all fittings, appurtenances, excavation, compaction, backfill, flushing, testing and disinfection as shown on the Contract Drawings and Specifications.

**3.80. BID ITEM NO. C.03 – FURNISH AND INSTALL AIR VALVE VAULT**

- A. Measured as a lump sum for an air valve vault as shown on the Contract Drawings for the 18-inch CCWTP transmission pipeline.
- B. Payment includes all labor and materials required for furnishing and installing the air valve vault as shown on the Contract Drawings and Specifications, including a precast concrete manhole structure, piping, fittings and appurtenances, excavation, backfill, compaction, flushing, testing and disinfection.

**3.81. BID ITEM NO. C.04 – TESTING AND COMMISSIONING OF NEW PIPELINE**

- A. Measured to include all testing and commissioning of new Ductile Iron 18-inch CCWTP transmission pipeline and the components therein.
- B. Payment shall include, but not be limited to, all labor, equipment, and materials required for all labor performed and materials installed. Testing shall include, but not be limited to, verifying all components are working in accordance with the Contract Drawings and Specifications, verifying all components are in full operational condition, and that the transmission pipeline has been flushed, tested and disinfected.

**SCHEDULE D**

**3.82. BID ITEM NO. D.01 – FURNISH AND INSTALL PRIMUS LINER IN EXISTING 18-INCH DIA. CCWTP TRANSMISSION PIPELINE (FROM HIGH POINT TO 18-INCH X 12-INCH TEE AT STA 18+05.19)**

- A. Measured along the pipeline with no deduction for fittings or manholes. No measurement and payment for over excavation and backfill unless approved in writing by ENGINEER.
- B. Payment includes all labor and materials required for furnishing and installing the primus liner in the existing 18-inch diameter City Creek Water Treatment Plant transmission line from the “High Point” to the 18-inch x 12-inch tee at Station 18+05.19 as shown on the Contract Drawings and Specifications.

**3.83. BID ITEM NO. D.02 – TESTING AND COMMISSIONING OF LINED PIPE**

- A. Measured to include all testing and commissioning of lined Cast Iron 18-inch CCWTP transmission pipeline and the components therein.
- B. Payment shall include, but not be limited to, all labor, equipment, and materials required for all labor performed and materials installed. Testing shall include, but not be limited to, verifying all components are working in accordance with the Contract Drawings and Specifications, verifying all components are in full operational condition, and that the transmission pipeline has been flushed, tested and disinfected.

END OF DOCUMENT

**DOCUMENT 00 43 36**  
**PROPOSED SUBCONTRACTOR FORM**

**PART 1 GENERAL**

**1.1 BIDDER**

A. Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

B. Telephone Number: \_\_\_\_\_

**1.2 CONSTRUCTION CONTRACT**

A. **MP3.16 – NORTH BENCH PUMP STATION**

**925 North Hilltop Road, Salt Lake City, UT 84103**

**Project No. 513416337**

**PART 2 REPORT**

**2.1 SUBCONTRACTOR AND SUPPLIER REPORT**

- A. Failure of Bidder to specify a Subcontractor for any portion of the Work constitutes an agreement by Bidder that Bidder is fully qualified to perform that portion and that Bidder shall perform that portion. See Instructions to Bidders (Document 00 21 13, paragraph 3.4B for additional information concerning the subcontractors and the nature and extent of any work that must be listed on this form.
- B. Bidder will be fully responsible to OWNER for the acts and omissions of Subcontractors and Suppliers and of persons either directly or indirectly employed by them, as Bidder is for the acts and omissions of persons employed by Bidder directly.
- C. Nothing contained in the Contract Documents shall create any contractual relationship between any Subcontractor or Supplier and OWNER. Bidder agrees that each subcontract with Bidder's Subcontractor will disclaim any third party or direct relationship between OWNER and any Subcontractor or Supplier.
- D. The names and addresses of the Subcontractors and Suppliers who will work under the terms of the Contract Documents and the estimated dollar amount of each subcontract, as appropriate, are set forth in the following tables.

<b>SUBCONTRACTORS</b>		
<b>Name</b>	<b>Nature and Extent of Work to be Subcontracted</b>	<b>Amount</b>
1.		
2.		
3.		
Total \$ _____ Percent of Total Contract _____%		
<b>SUPPLIERS</b>		
<b>Name</b>	<b>Nature and Extent of Work to be Supplied</b>	<b>Amount</b>
1.		
2.		
3.		
4.		

## **PART 3 EXECUTION**

### **3.1 EFFECTIVE DATE**

A. Bidder executes this Subcontractor and Supplier report and declares it to be a supplement to the Bid (Document 00 41 00) and in effect as of \_\_\_\_\_, 20\_\_\_\_

### **3.2 BIDDER'S SUBSCRIPTION**

A. Bidder's signature: \_\_\_\_\_  
 B. Please print Bidder's name here: \_\_\_\_\_  
 C. Title: \_\_\_\_\_

END OF DOCUMENT

**DOCUMENT 00 43 37**  
**WORK UNDER CONTRACT REPORT**

**PART 1 GENERAL**

**1.1 BIDDER**

A. Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

B. Telephone Number: \_\_\_\_\_

**1.2 CONSTRUCTION CONTRACT**

A. **MP3.16 – NORTH BENCH PUMP STATION**

**925 North Hilltop Road, Salt Lake City, UT 84103**

Project No. 513416337

**PART 2 REPORT**

**2.1 STATUS OF WORK UNDER CONTRACT**

- A. The completion and submission to OWNER of the following table by Bidder is required within 7 calendar days after ENGINEER's request per Article 3.1 of the Instructions to Bidders (Document 00 21 13). OWNER may declare Bidder non-responsive if this report is not submitted on time.
- B. The successful Bidder is required to notify OWNER in writing of any new contracts awarded before the execution of the Construction Contract.

**STATUS OF WORK UNDER CONTRACT**

	Description of Contract And for Whom Performed	Date of Award	Amount of Contract	Contract Completion Date	Percent Complete	Scheduled Completion Date	Dollar Amount Outstanding
1							
2							
3							
4							
5							
6							

	Description of Contract And for Whom Performed	Date of Award	Amount of Contract	Contract Completion Date	Percent Complete	Scheduled Completion Date	Dollar Amount Outstanding
7							
8							
9							
10							

Total of Dollar Amount Outstanding \$ \_\_\_\_\_

CONTRACTOR's Bid for this Project \$ \_\_\_\_\_

TOTAL \$ \_\_\_\_\_

C. Add supplemental sheets if necessary to account for all work under contract.

### **PART 3 EXECUTION**

#### **3.1 EFFECTIVE DATE**

A. Bidder executes this Work Under Contract Report and declares it to be a supplement to the Bid (Document 00 41 00) and in effect as of \_\_\_\_\_, 20\_\_\_\_.

#### **3.2 BIDDER'S SUBSCRIPTION**

A. Bidder's signature: \_\_\_\_\_

B. Please print Bidder's name here: \_\_\_\_\_

C. Title: \_\_\_\_\_

END OF DOCUMENT



**DOCUMENT 00 43 38**  
**BIDDER STATUS REPORT**

**PART 1 GENERAL**

**1.1 BIDDER**

- A. Name: \_\_\_\_\_
- B. Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- C. Telephone number: \_\_\_\_\_

**1.2 CONSTRUCTION CONTRACT**

- A. **MP3.16 – NORTH BENCH PUMP STATION**  
**925 North Hilltop Road, Salt Lake City, UT 84103**  
**Project No. 513416337**

**PART 2 REPORT**

**2.1 BIDDER STATUS REPORT**

- A. Bidder affirms that the following information is true and correct.
1. Number of employees: \_\_\_\_\_
  2. Bidder's firm is: (check all of the following that are applicable)
    - ☐ Independently owned and operated.
    - ☐ An affiliate of\*
    - ☐ A subsidiary of\*
    - ☐ A division of\*
    - ☐ A business with gross revenue in excess of \$ \_\_\_\_\_
    - ☐ A business with gross revenue below \$ \_\_\_\_\_
- \* PARENT COMPANY:
- Name: \_\_\_\_\_
- Address: \_\_\_\_\_
- Telephone Number: \_\_\_\_\_
- Email address: \_\_\_\_\_

## **PART 3    EXECUTION**

### **3.1    EFFECTIVE DATE**

A. Bidder executes this status report and declares it to be a supplement to the Bid Form (Document 00 41 00) and in effect as of \_\_\_\_\_, 20 \_\_\_\_.

### **3.2    BIDDER'S SUBSCRIPTION**

A. Bidder's Signature: \_\_\_\_\_

B. Please print Bidder's name here: \_\_\_\_\_

C. Title: \_\_\_\_\_

END OF DOCUMENT

**DOCUMENT 00 43 45**

## 1.1 BIDDER

B. Address: \_\_\_\_\_

## 1.2 CONSTRUCTION CONTRACT

**925 North Hilltop Road, Salt Lake City, UT 84103**

### 1.3 CERTIFICATION

as defined in Section 3.24.115 of the Salt Lake City Code means the same as that term defined in Section 26-40-115, Utah Code Annotated, as amended, or its successor:

1. A health benefit plan and employer contribution level with a combined actuarial value at least actuarially equivalent to the combined actuarial value of the benchmark plan found at <http://www.health.utah.gov/chip/PDF/2016Benchmark.pdf> determined by the Children's Health Insurance Program under Utah Code Section 26-40-106(1) and a contribution level at which the employer pays at least 50% of the premium for the employee and the dependents of the employee who reside or work in Utah; or
2. A federally qualified high deductible health plan that at a minimum:
  - a. Has a deductible that is :
    - i. The lowest deductible permitted for a federally qualified high deductible health plan; or
    - ii. A deductible that is higher than the lowest deductible permitted for a federally qualified high deductible health plan, but includes an employer contribution to a health savings account in a dollar

- amount at least equal to the dollar amount difference between the lowest deductible permitted for a federally qualified high deductible plan and the deductible for the employer offered federally qualified high deductible plan;
- b. Has an out-of-pocket maximum that does not exceed three times the amount of the annual deductible; and
  - c. Provides that the employer pays 60% of the premium for the employee and the dependents of the employee who work or reside in Utah.

## **PART 3 EXECUTION**

### **3.1 EFFECTIVE DATE**

- A. Bidder executes this form, a supplement to the Bid Form (Document 00 41 00), and declares it to be true and correct and in effect as of \_\_\_\_\_, 20 \_\_\_\_.

### **3.2 BIDDER'S SUBSCRIPTION**

- A. Bidder's signature: \_\_\_\_\_
- B. Please print Bidder's name here: \_\_\_\_\_
- C. Title: \_\_\_\_\_

END OF DOCUMENT

**DOCUMENT 00 43 46**  
**WORK ENVIRONMENT CERTIFICATION FORM**

**PART 1 GENERAL**

**1.1 BIDDER**

A. Name: \_\_\_\_\_

B. Address: \_\_\_\_\_

\_\_\_\_\_

C. Telephone number: \_\_\_\_\_

**1.2 CONSTRUCTION CONTRACT**

A. **MP3.16 – NORTH BENCH PUMP STATION**

**925 North Hilltop Road, Salt Lake City, UT 84103**

**Project No. 513416337**

**1.3 AFFIDAVIT**

A. Bidder, on behalf of Bidder and every subcontractor under Bidder, if any, affirms that the following information is true and correct.

1. Bidder and every subcontractor, if any, provides and will maintain the following as defined in Section 3.24.115 of the Salt Lake City Code for the duration of the contract.

a.	A drug and alcohol testing policy during the period of the contract.	Yes _____ Initial No _____ Initial
b.	A program to actively recruit and/or employ veterans.	Yes _____ Initial No _____ Initial
c.	A job training program.	Yes _____ Initial No _____ Initial

d.	A safety program.	Yes _____ Initial _____ No _____ Initial _____
e.	A formal policy of non-discrimination consistent with federal, state, and local law.	Yes _____ Initial _____ No _____ Initial _____

### **PART 3 EXECUTION**

#### **3.1 EFFECTIVE DATE**

A. BIDDER executes this form and declares it to be true and correct and in effect as of \_\_\_\_\_, 20 \_\_\_\_.

#### **3.2 BIDDER'S SUBSCRIPTION**

A. BIDDER's signature: \_\_\_\_\_

B. Please print BIDDER's name here: \_\_\_\_\_

C. Title: \_\_\_\_\_

END OF DOCUMENT

## DOCUMENT 00 52 00 AGREEMENT

This Agreement is dated as of the date that the City Recorder attests the applicable City signature, which date shall be the recordation date, and is between Salt Lake City Corporation, a Utah municipal corporation, 1530 S. West Temple, Salt Lake City, Utah 84115-5223 (OWNER or City) and the following entity (CONTRACTOR)

Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Telephone number: \_\_\_\_\_

Email address: \_\_\_\_\_

For valuable consideration, the receipt of which the parties acknowledge, OWNER and CONTRACTOR agree to the following.

### PART 1 GENERAL

#### 1.1 DEFINITIONS

- A. Words used in this Agreement, in any Qualified Health Insurance Supplemental Agreement (Document 00 54 16), in any Value Program Supplemental Agreement (Document 00 54 15), and in any Supplemental Agreement (Document 00 54 00) related hereto that are defined in Document 00 72 00 in the current Edition of the Manual of Standard Specifications published by the Utah Chapter of the American Public Works Association shall have meaning as defined therein.

#### 1.2 WORK

- A. CONTRACTOR shall provide the construction and services specified in the Drawing and Specifications in the Construction Contract known as:

**MP3.16 – NORTH BENCH PUMP STATION**

**925 North Hilltop Road, Salt Lake City, UT 84103**

**Project No. 513416337**

- B. CONTRACTOR shall comply with its obligations under the Contract Documents.

#### 1.3 ENGINEER

- A. **JASON DRAPER, P.E.**, is the OWNER's representative and agent who has the rights, authority, and duties assigned to ENGINEER in the Contract Documents.

#### 1.4 ASSIGNMENT NOT BINDING WITHOUT WRITTEN CONSENT

- A. No assignment of any right or interest in the Construction Contract shall be made without written consent of OWNER and CONTRACTOR. No assignment will release or discharge OWNER or CONTRACTOR from any duty or responsibility under the

Construction Contract unless specifically stated to the contrary in any written consent to an assignment.

- B. CONTRACTOR shall make no assignment of money that is due without OWNER's written consent (except to the extent that the effect of this restriction may be limited by Law or Regulation).

#### **1.5 BINDING TERMS**

- A. OWNER and CONTRACTOR each binds itself, its partners, successors, assigns, and legal representatives to the other party hereto, its partners, successors, assigns, and legal representatives in respect to all covenants, agreements, and obligations contained in the Construction Contract.

#### **1.6 REPRESENTATION REGARDING ETHICAL STANDARDS FOR CITY OFFICERS AND EMPLOYEES AND FORMER CITY OFFICERS AND EMPLOYEES**

##### **A. CONTRACTOR represents that it has not:**

- 1. Provided an illegal gift or payoff to a City officer or employee or former City officer or employee, or his or her relative or business entity.**
- 2. Retained any person to solicit or secure this contract upon an agreement or understanding for a commission, percentage, or brokerage or contingent fee, other than bona fide employees or bona fide commercial selling agencies for the propose of securing business.**
- 3. Knowingly breached any of the ethical standards set forth in City's conflict of interest ordinance, Chapter 2.44, Salt Lake City Code; or**
- 4. Knowingly influenced, and hereby promises that it will not knowingly influence, a City officer or employee or former City officer or employee to breach any of the ethical standards set forth in City's conflict of interest ordinance, Chapter 2.44, Salt Lake City Code.**

## **PART 2 TIME AND MONEY CONSIDERATIONS**

#### **2.1 CONTRACT PRICE**

- A. The Contract Price includes the cost of the Work specified in the Contract Documents, plus the cost of all bonds, insurance, permits, and fees, and all charges, expenses, and assessments of whatever kind or character.
- B. The Schedules of Prices awarded from the Bid Schedule (Document 00 43 00) are as follows.
  1. \_\_\_\_\_
- C. An Agreement Supplement (Document 00 54 00) is not attached to this Agreement.
- D. A Qualified Health Insurance Supplemental Agreement (Document 00 54 16) is not attached to this Agreement.
- E. A Value Program Supplemental Agreement (Document 00 54 15) is not attached to this Agreement.



- F. Based upon the above-awarded schedules and the Agreement Supplement (if any), the Contract Price awarded is: \_\_\_\_\_

( \$ \_\_\_\_\_ ).

## 2.2 CONTRACT TIME

- A. Contract Time shall:

1. Be 730 calendar days after the date of the Notice to Proceed.

- B. Any time specified in work sequences in the Summary of Work (Section 01 11 00) shall be a part of the Contract Time.

## 2.3 PUNCH LIST TIME

- A. CONTRACTOR shall complete all Work within 30 days after CONTRACTOR receives ENGINEER's Final Inspection Punch List unless ENGINEER grants additional time in writing or an exception has been specified in the Contract Documents.
- B. Permitting CONTRACTOR to continue and finish the Work or any part of the Work after the time fixed for its completion, or after the date to which the time for completion may have been extended, whether or not a new completion date is established, shall in no way operate as a waiver on the part of OWNER of any of OWNER's rights.

## 2.4 LIQUIDATED DAMAGES

- A. CONTRACTOR agrees that OWNER will suffer damage or financial loss if the Work is not completed within the Contract Time, if sequenced work is not completed on time, or if public services are interrupted. CONTRACTOR and OWNER agree that the exact amount of damage or loss is difficult to determine.
- B. OWNER shall be entitled to deduct and retain liquidated damages out of any money that may be due or become due CONTRACTOR. To the extent liquidated damages exceed any amounts due CONTRACTOR, CONTRACTOR shall be liable for such amounts and shall return such amounts to OWNER.
- C. Instead of requiring proof of damage or specific financial loss, CONTRACTOR shall pay the following sums to OWNER as liquidated damages and not as a penalty. Such liquidated damages shall relate only to the additional administrative costs and expenses incurred by OWNER and shall not prevent OWNER from pursuing other remedies or collecting actual damages for damage or loss other than administrative costs and expenses.
1. **Late Completion:** One thousand dollars and 00 cents (\$ 1,000.00) for each day or part thereof that expires after the Contract Time until the Work is Substantially Complete as provided in Article 14.5 of the General Conditions (Document 00 72 00).
  2. **Late Punch List Time Completion:** Fifty (50%) percent of the amount specified for Late Contract Time Completion for each day or part thereof that the Work remains incomplete after the Punch List Time. The Punch List shall be considered received by CONTRACTOR on the day it is transmitted by email or hand delivery or the day it is received by registered or certified mail.
  3. **Work Sequence Completion:** If a Work sequence is specified, then for each day or part thereof that exceeds the specified time and until ENGINEER determines that such

Work sequence is Substantially Complete, CONTRACTOR shall pay the following sums to OWNER.

- a. Work Sequence 1: \_\_\_\_\_ dollars  
and \_\_\_\_\_ cents (\$ \_\_\_\_\_) per day.
  - b. Work Sequence 2: \_\_\_\_\_ dollars  
and \_\_\_\_\_ cents (\$ \_\_\_\_\_) per day.
4. **Survey Monuments:** \$1,000.00 if a land survey monument is disturbed or moved and ENGINEER's surveyor has not referenced the survey monument for resetting.
  5. **Interruption of Public Services:** No interruption of public services shall be caused by CONTRACTOR, its agents, or employees, without ENGINEER's prior written approval.

## 2.5 RETAINAGE

- A. **Retainage is at OWNER's Option:** OWNER may, in its sole discretion, retain and withhold up to five percent of any payment due to CONTRACTOR under the Construction Contract, but the total retention may not exceed five percent of the total Contract Price. If, in ENGINEER's opinion, the Work is proceeding in accordance with CONTRACTOR's approved progress schedule, and all progress schedule submittals are current and up to date, and all required payrolls, Shop Drawings, and miscellaneous submittals are current and up to date, OWNER may choose not to withhold retainage.
  1. **Payments:** At any time after 50 percent of the Work has been completed and if \$50,000 or more has been retained, OWNER may make any of the remaining progress payments in full if, in OWNER's sole discretion, the Work is progressing satisfactorily. While CONTRACTOR is carrying on the Work, OWNER may pay monthly the balance not retained as aforesaid, after deducting all previous payments and all sums to be kept or retained under the provisions of the Construction Contract. No such payment shall be required to be made when, in the judgment of ENGINEER, the Work is not proceeding in accordance with the Contract Documents or when in ENGINEER's judgment the total value of the Work done since the last estimate amounts to less than \$300. No such payment shall be construed to be an acceptance of any defective or improper Work or materials.
  2. **Reducing the Retainage:** As the Work nears completion and solely at ENGINEER's discretion, OWNER may reduce the retainage to an amount more in line with the Work actually remaining.
- B. **Interest:** Any money retained by OWNER shall be placed in an interest-bearing account held by OWNER as of the date such money would have otherwise been payable. The interest accrued thereon shall be for the benefit of CONTRACTOR.
- C. **Release of Retainage and Interest:** Any retained moneys and any accrued interest thereon shall be released to CONTRACTOR pursuant to a billing statement from CONTRACTOR within 45 days after the later of: 1) the date that OWNER receives the billing statement from CONTRACTOR; 2) the date that a certificate of occupancy or final acceptance notice is issued to CONTRACTOR or OWNER; 3) the date that OWNER does not issue a certificate of occupancy but permits partial or complete occupancy of a

newly constructed or remodeled building at the Project; or (4) the date that CONTRACTOR accepts the final pay quantities.

- D. **Other Retainage:** Notwithstanding paragraph 2.5A: 1) if CONTRACTOR is in default or breach of the terms and conditions of the Construction Contract, OWNER may withhold from payment for as long as reasonably necessary an amount necessary to cure the breach or default of CONTRACTOR; or 2) if the Project or a portion of the Project has been substantially completed, OWNER may retain until completion up to twice the fair market value of the Work of CONTRACTOR that has not been completed in accordance with the Construction Contract.

## 2.6 PAYMENT PROCEDURES

- A. **Progress Payments:** CONTRACTOR shall submit Applications for Payment in accordance with Part 14 of the General Conditions (Document 00 72 00). Payment shall not become due or payable for any contract item not provided or installed by CONTRACTOR. As work is performed, OWNER shall pay money due to CONTRACTOR.
1. **Withholding Payment:** OWNER reserves the right to withhold payment from CONTRACTOR for non-compliance with any provision of the Contract Documents.
  2. **Price Adjustments:** OWNER will consider making partial payment to CONTRACTOR for certain non-conforming work in advance of any negotiated settlement reached between CONTRACTOR and OWNER, provided CONTRACTOR requests in writing that this be done. CONTRACTOR agrees that any such payments made by OWNER are "payments in advance" and that any money that becomes due when the final settlement is negotiated will not constitute payments "withheld" or "retained" under State law.
  3. **Pay Applications** must be submitted to ENGINEER through SLCDPU Engineering's Project Central SharePoint site. Access and use instructions are provided at the end of Section 01 33 00 and must include, at a minimum, the following;
    - a. SLCDPU Continuation Sheet with schedule of values populated by SLCDPU.
    - b. Schedule of values.
- B. **Final Payment:** After completion of all Work and Punch List items, OWNER shall pay the Contract Price due after deducting all previous payments, unit price quantity adjustments, penalties, liquidated damages, and other amounts to be retained. All prior progress payments shall be subject to correction in the final payment. The final payment shall not be due and payable until 30 days after approval of the request for final payment by OWNER's finance department.
1. **Submittal:** Final payment shall not be made until CONTRACTOR has delivered and ENGINEER has accepted all submittals specified in Article 14.8 of the General Conditions (Document 00 72 00).
  2. **OWNER Released From Claims:** The payment and acceptance of the final Contract Price due and the adjustment and payment for any Work done in accordance with any alterations of the same shall release OWNER from any and all claims of CONTRACTOR on account of Work performed under the Contract Documents or any

Modification thereof, except for those claims specifically agreed to by OWNER as reserved and unresolved.

## **2.7 EXTRA WORK**

- A. No money will be paid to CONTRACTOR for any additions, deletions, or revisions in the Work as stipulated in Article 10.1 of the General Conditions (Document 00 72 00), unless a Contract Modification for such has been made in writing and executed by OWNER and CONTRACTOR.

## **PART 3 EXECUTION**

### **3.1 EFFECTIVE DATE**

- A. OWNER and CONTRACTOR executed this Agreement and declare the Effective Date of the Construction Contract to be the same as the recordation date.

### **3.2 CONTRACTOR'S SUBSCRIPTION AND ACKNOWLEDGEMENT**

- A. Name of organization: \_\_\_\_\_
- B. Type of organization: \_\_\_\_\_  
(Corporation, partnership, limited liability company, individual, etc.)
- C. CONTRACTOR's Utah license number: \_\_\_\_\_
- D. CONTRACTOR's signature: \_\_\_\_\_
- E. Please print name here: \_\_\_\_\_
- F. Title: \_\_\_\_\_

**G. Business Entity Acknowledgement:**

STATE OF UTAH )

: ss.

COUNTY OF SALT LAKE )

The foregoing instrument was acknowledged before me this \_\_\_\_ day of \_\_\_\_\_,  
20\_\_, by \_\_\_\_\_, the \_\_\_\_\_ of  
[Name of signer] [Title of signer]

\_\_\_\_\_, a \_\_\_\_\_.  
[Name of entity] [State where organized and type of entity]

\_\_\_\_\_  
Notary's signature

\_\_\_\_\_  
Residing in

\_\_\_\_\_  
My commission expires:

Notary's seal

**H. Signature Authority:** At the request of OWNER, evidence satisfactory to OWNER shall be submitted that shows that the person executing this Agreement has the required authority to execute this Agreement. For a corporation such evidence will be in the bylaws or a resolution of the board of directors. For a limited liability company such evidence will be in the operating agreement.

**3.3 OWNER'S SUBSCRIPTION AND ATTESTATION**

**A. Refer to Adobe's Final Audit Signature Page(s) for OWNERS SUBSCRIPTION AND ATTESTATION.**

END OF DOCUMENT

**DOCUMENT 00 61 13**  
**PERFORMANCE BOND**

**PART 1 GENERAL**

**1.1 BOND**

- A. Number: \_\_\_\_\_.
- B. Amount: \_\_\_\_\_  
\_\_\_\_\_ dollars (\$ \_\_\_\_\_).

**1.2 SURETY**

- A. Name: \_\_\_\_\_
- B. Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- C. Telephone number: \_\_\_\_\_
- D. Email address: \_\_\_\_\_

**1.3 CONTRACTOR**

- A. Name: \_\_\_\_\_
- B. Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
- C. Telephone number: \_\_\_\_\_
- D. Email address: \_\_\_\_\_

**1.4 OWNER**

- A. Salt Lake City Corporation, a Utah municipal corporation, 1530 S. West Temple, Salt Lake City, Utah 84115-5223.

**1.5 CONSTRUCTION CONTRACT**

- A. **MP3.16 – NORTH BENCH PUMP STATION**  
**925 North Hilltop Road, Salt Lake City, UT 84103**  
**Project No. 513416337**

**1.6 DEFINED TERMS**

- A. Terms used in this Performance Bond which are defined in Article 1.1 of the General Conditions (Document 00 72 00) will have the meanings indicated in the General Conditions.

## **PART 2 COVENANTS**

### **2.1 SURETY'S AND CONTRACTOR'S RELATIONSHIP**

- A. The Surety, as surety, and the CONTRACTOR, as principal, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the OWNER, as obligee, for the performance of the Construction Contract.
- B. If the CONTRACTOR performs the Construction Contract, the Surety and the CONTRACTOR shall have no obligation under this Bond; otherwise this Bond shall remain in full force and effect.

### **2.2 NOTICE**

- A. Notice to the Surety, the OWNER, or the CONTRACTOR shall be sent by secured email, registered or certified mail, postage prepaid, by hand delivery, or by overnight delivery service for which a delivery receipt is required, to the address shown on this Bond.
- B. Notices sent as provided in Section 2.2A shall be effective on the date on which such notice was sent.
- C. Notice may be sent by email. Email notice shall be effective on the date of submission provided that a confirmation receipt establishing the successful submission of the notice is sent by providing a "Delivery Request Receipt" and "Read Request Receipt", no later than twenty-four (24) hours after the email notice is transmitted.
- D. If any notice requires a period of less than seven (7) days for response, the notice shall be sent by email.
- E. If the time for response to any notice expires on a Saturday, Sunday, or a legal holiday in the State of Utah, the time shall be extended to the next business day.

### **2.3 PROCEDURE TO INVOKE SURETY'S OBLIGATION**

- A. If the CONTRACTOR fails to perform any of its obligations under the Construction Contract, and such failure to perform has not been waived by the OWNER, the OWNER may notify the CONTRACTOR and the Surety, at their addresses described above, that the CONTRACTOR is in default, and may formally terminate the CONTRACTOR's right to perform its obligations under the Construction Contract.
- B. If the Construction Contract is terminated, the OWNER shall pay the unpaid Balance of the Contract Price to the Surety for completion of the Work in accordance with the terms of the Construction Contract or to a contractor selected by the Surety to perform the Work in accordance with the terms of the Construction Contract.

### **2.4 SURETY'S OPTIONS AT CONTRACTOR TERMINATION**

- A. Surety Completes the Work: The Surety may undertake to perform and complete the Work itself, through its agents, or through independent contractors.
- B. Surety Obtains Bids or Proposals: The Surety may obtain bids or negotiated proposals from qualified contractors acceptable to the OWNER for a contract for performance and completion of the Work.
  - 1. Such bids or proposals shall be prepared by the Surety for execution by the OWNER and the completion contractor selected.
  - 2. The Surety shall secure the contract with performance and payment bonds executed by a qualified surety equivalent to this Bond and the payment bond (Document 00 61 14).



3. The Surety shall pay to the OWNER the amount of damages as described in Section 2.6 in excess of the balance of the Contract Price incurred by the OWNER resulting from the CONTRACTOR's default.
- C. Surety to Pay OWNER: The Surety may determine the amount, not to exceed the amount of this Bond specified in Section 1.1B, for which the Surety believes it may be liable to pay, and tender payment therefore to the OWNER. The OWNER has sole discretion to accept payment.

## **2.5 PROCEDURE FOR OWNER TO DECLARE SURETY IN DEFAULT**

- A. The OWNER may declare the Surety to be in default pursuant to the following procedures:
  1. The OWNER shall issue an additional written notice to the Surety, after declaring the CONTRACTOR in default as provided in Section 2.3, demanding that the Surety perform its obligations under this Bond; and
  2. The Surety shall respond to the OWNER within 15 days after receipt of the OWNER's additional notice, either denying the claim or accepting liability and exercising its options under Section 2.4.
- B. If the OWNER declines to accept the payment tendered by the Surety pursuant to Section 2.4(C), or if the Surety has denied the claim in whole or in part, the OWNER, without further notice, may pursue any remedies available to the OWNER.

## **2.6 SURETY'S OBLIGATIONS**

- A. After the OWNER has terminated the CONTRACTOR's right to complete its obligations under the Construction Contract, and if the Surety elects to complete the Work under the Construction Contract as provided in Section 2.4, then the responsibilities of the Surety to the OWNER shall not be greater than those of the CONTRACTOR under the Construction Contract, and the responsibilities of the OWNER to the Surety shall not be greater than those of the OWNER under the Construction Contract.
- B. To the limit of the amount of this Bond, but subject to a commitment by the OWNER to pay all valid and proper payments made to or on behalf of the CONTRACTOR under the Construction Contract, the Surety is obligated, without duplication, for:
  1. the responsibilities of the CONTRACTOR for correction of Defective Work and completion of the Work under the Construction Contract;
  2. any additional legal, design professional, and delay costs resulting from the CONTRACTOR's default, and resulting from the actions or failure to act of the Surety under Section 2.4; and
  3. liquidated damages that are or may become due for any reason.

## **2.7 UNRELATED OBLIGATIONS OF THE CONTRACTOR**

- A. The Surety shall not be liable to the OWNER for obligations of the CONTRACTOR that are unrelated to the Construction Contract, and the balance of the Contract Price shall not be reduced or changed on account of any such unrelated obligations.
- B. No right of action shall accrue on this Bond to any person or entity other than the OWNER or its heirs, executors, administrators, or successors.

## **2.8 SURETY WAIVES NOTICE OF ANY CHANGE**

- A. Surety hereby waives notice of any change, including changes of Contract Time, Contract Price, and scope of Work, to the Construction Contract or to related subcontracts, purchase orders, and other obligations.

## 2.9 VENUE

- A. Any suit or action commenced by the OWNER under this Bond shall be in a court of competent jurisdiction in Salt Lake City, Utah.

## PART 3 EXECUTION

### 3.1 EFFECTIVE DATE

- A. The Surety and the CONTRACTOR executed this Bond and declared it to be in effect as of the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

### 3.2 CONTRACTOR'S SUBSCRIPTION AND ACKNOWLEDGMENT

- A. Name of organization: \_\_\_\_\_
- B. Type of organization: \_\_\_\_\_  
(corporation, partnership, limited liability company, individual, etc.)
- C. CONTRACTOR's signature: \_\_\_\_\_
- D. Print name here: \_\_\_\_\_
- E. Title: \_\_\_\_\_

**F. Business Entity Acknowledgement:**

STATE OF UTAH )  
 : ss.  
COUNTY OF SALT LAKE)

The foregoing performance bond was acknowledged before me this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by \_\_\_\_\_, the  
[Name of signer]  
\_\_\_\_\_ of \_\_\_\_\_,  
[Title of signer] [Name of entity]  
a \_\_\_\_\_  
[State where organized and type of entity]

---

Notary's signature

---

Residing in

---

My commission expires:

Notary's seal

G. **Signature Authority:** At the request of OWNER, CONTRACTOR shall submit to OWNER evidence satisfactory to OWNER that shows that the person executing this Bond has the required authority to execute this Bond. For a corporation such evidence will be in the bylaws or a resolution of the board of directors. For a limited liability company such evidence will be in the operating agreement.

### 3.3 SURETY'S SUBSCRIPTION AND ACKNOWLEDGMENT

A. Attach evidence of Surety's corporate authority to sign.

B. Surety's signature: \_\_\_\_\_

C. Please print name here: \_\_\_\_\_

D. Title: \_\_\_\_\_

E. Acknowledgment:

STATE OF UTAH )

:

COUNTY OF \_\_\_\_\_)

The foregoing performance bond was acknowledged before me this \_\_ day of \_\_\_\_\_, 20\_\_ by \_\_\_\_\_,

(Name of signee)

the \_\_\_\_\_ of \_\_\_\_\_,

(Title of signee)

(Name of entity)

a \_\_\_\_\_.

(State where organized and type of entity)

\_\_\_\_\_  
Notary's signature

\_\_\_\_\_  
Residing in

\_\_\_\_\_  
My commission expires:

Notary's seal

END OF DOCUMENT

**DOCUMENT 00 61 14**  
**PAYMENT BOND**

**PART 1 GENERAL**

**1.1 BOND**

A. Number: \_\_\_\_\_  
B. Amount: \_\_\_\_\_  
\_\_\_\_\_ dollars (\$ \_\_\_\_\_)

**1.2 SURETY**

A. Name: \_\_\_\_\_  
B. Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
C. Telephone number: \_\_\_\_\_  
D. Email address: \_\_\_\_\_

**1.3 CONTRACTOR**

A. Name: \_\_\_\_\_  
B. Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
C. Telephone number: \_\_\_\_\_  
D. Email address: \_\_\_\_\_

**1.4 OWNER**

A. Salt Lake City Corporation, a Utah municipal corporation, 1530 S. West Temple, Salt Lake City, Utah 84115-5223.

**1.5 CONSTRUCTION CONTRACT**

A. **MP3.16 – NORTH BENCH PUMP STATION**  
**925 North Hilltop Road, Salt Lake City, UT 84103**  
**Project No. 513416337**

**1.6 DEFINED TERMS**

A. Terms used in this Payment Bond that are defined in Article 1.1 of the General Conditions (Document 00 72 00) will have the meanings indicated in the General Conditions.

## **PART 2 COVENANTS**

### **2.1 SURETY's AND CONTRACTOR's RELATIONSHIP**

- A. The Surety as surety, and the CONTRACTOR, as principal, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to the OWNER, as obligee, to pay for labor, materials, and equipment furnished for use in the performance of the Construction Contract.
- B. If the CONTRACTOR makes payment for all labor, materials, and equipment furnished for use in the performance of the Construction Contract, the Surety and the CONTRACTOR shall have no obligation under this Bond; otherwise this Bond shall remain in full force and effect.

### **2.2 NOTICE**

- A. Notice to the Surety, the OWNER, or the CONTRACTOR shall be sent by secured email, registered or certified mail, postage prepaid, by hand delivery, or by overnight delivery service for which a delivery receipt is required, to the address shown on this Bond.
- B. Notices sent as provided in Section 2.2A shall be effective on the date on which such notice was sent.
- C. Notice may be sent by email. Email notice shall be effective on the date of submission provided that a confirmation receipt establishing the successful submission of the notice is sent by providing a "Delivery Request Receipt" and "Read Request Receipt", no later than twenty-four (24) hours after the email notice is transmitted.
- D. If any notice requires a period of less than seven (7) days for response, the notice shall be sent by email.
- E. If the time for response to any notice expires on a Saturday, Sunday, or a legal holiday in the State of Utah, the time shall be extended to the next business day.

### **2.3 CONDITIONS OF SURETY'S LIABILITY**

- A. With respect to the OWNER, this Bond shall be null and void if the CONTRACTOR promptly takes the following actions:
  - 1. makes payment, directly or indirectly, for all sums due Claimants; and
  - 2. defends, indemnifies, and saves harmless the OWNER from all claims, demands, Liens, or suits by any person or entity who furnished labor, materials, or equipment for use in the performance of the Work, provided the OWNER has tendered defense of such claims, demands, Liens, or suits to the CONTRACTOR and the Surety.

### **2.4 PROCEDURE TO INVOKE SURETY'S OBLIGATION**

- A. **Concerning Claimants who have a Direct Contract with the CONTRACTOR:** The Surety shall have no obligation to Claimants under this Bond who are employed by or have a direct contract with the CONTRACTOR until such Claimants have given notice to the Surety at the address shown on this Bond and have sent a copy, or notice thereof, to the OWNER, stating that a claim is being made under this Bond and, with substantial accuracy, stating the amount of the claim.
- B. **Concerning a Claimant who does not have a Direct Contract with the CONTRACTOR:** The Surety shall have no obligation to a Claimant under this Bond who does not have a direct contract with the CONTRACTOR until such Claimant takes the following actions.

1. The Claimant furnishes written notice to the CONTRACTOR and sends a copy, or notice thereof, to the OWNER, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed;
2. The Claimant either receives a rejection in whole or in part from the CONTRACTOR, or does not receive within 15 days after furnishing the above notice any communication from the CONTRACTOR by which the CONTRACTOR indicates that the claim will be paid directly or indirectly; and
3. Not having been paid within the above 15 days, the Claimant sends a written notice to the Surety at the address described on this Bond and sends a copy, or notice thereof, to the OWNER stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the CONTRACTOR.

## **2.5 SURETY'S OPTION TO SETTLE CLAIMS**

- A. When the Claimant has satisfied the conditions of Section 2.4, the Surety shall promptly and at the Surety's expense take the following actions:
  1. Send an answer to the Claimant, with a copy to the OWNER, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed; and
  2. Pay or arrange for payment of any undisputed amounts.

## **2.6 SURETY'S OBLIGATION**

- A. The Surety's total obligation under this Bond shall not exceed the amount of this Bond, and the amount of this Bond shall be reduced in the amount of any payments made in good faith by the Surety.

## **2.7 UNRELATED OBLIGATIONS OF THE CONTRACTOR**

- A. The Surety and the OWNER shall not be liable to Claimants or others for obligations of the CONTRACTOR that are unrelated to the Construction Contract.
- B. The OWNER shall not be liable for payment of any damages, costs, or expenses of any Claimant under this Bond, and shall have under this Bond no obligation to make payments to, give notices on behalf of, or otherwise have obligations to Claimants under this Bond.

## **2.8 SURETY WAIVES NOTICE OF ANY CHANGE**

- A. Surety hereby waives notice of any change to the Construction Contract including changes of Contract Time, Contract Price, and Scope of Work, or to related subcontracts, purchase orders, or other obligations.

## **2.9 VENUE**

- A. Any suit or action commenced by a Claimant under this Bond shall be in a court of competent jurisdiction in Salt Lake City, Utah.

## **2.10 COPIES OF THIS BOND**

- A. Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the CONTRACTOR or the OWNER shall promptly furnish a copy of this Bond or shall permit a copy to be made.

## **PART 3    EXECUTION**

### **3.1    EFFECTIVE DATE**

- A. The Surety and the CONTRACTOR executed this Bond and declared it to be in effect as of the \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

### **3.2    CONTRACTOR'S SUBSCRIPTION AND ACKNOWLEDGMENT**

- A. Name of organization: \_\_\_\_\_
- B. Type of organization: \_\_\_\_\_  
(corporation, partnership, limited liability company, individual, etc.)
- C. CONTRACTOR's signature: \_\_\_\_\_
- D. Please print name here: \_\_\_\_\_
- E. Title: \_\_\_\_\_



**F. Business Entity Acknowledgement:**

STATE OF UTAH )  
 : ss.  
COUNTY OF \_\_\_\_\_)

The foregoing payment bond was acknowledged before me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_, by \_\_\_\_\_, the  
[Name of signer]  
\_\_\_\_\_, of \_\_\_\_\_,  
[Title of signer] [Name of entity]  
a \_\_\_\_\_  
[State where organized and type of entity]

Notary's signature

Residing in

My commission expires:

Notary's seal

G. **Signature Authority:** At the request of OWNER, CONTRACTOR shall submit to OWNER evidence satisfactory to OWNER that shows that the person executing this Bond has the required authority to execute this Bond. For a corporation such evidence will be in the bylaws or a resolution of the board of directors. For a limited liability company such evidence will be in the operating agreement.

### 3.3 SURETY'S SUBSCRIPTION AND ACKNOWLEDGMENT

A. Attach evidence of Surety's corporate authority to sign.

B. Surety's signature: \_\_\_\_\_

C. Print name here: \_\_\_\_\_

D. Title: \_\_\_\_\_

E. Acknowledgment:

STATE OF UTAH )

:

COUNTY OF \_\_\_\_\_)

The foregoing payment bond was acknowledged before me this \_\_\_\_ day of \_\_\_\_\_  
\_\_\_\_\_, 20\_\_ by \_\_\_\_\_,

(Name of signee)

the \_\_\_\_\_ of \_\_\_\_\_,

(Title of signee)

(Name of entity)

a \_\_\_\_\_.

(State where organized and type of entity)

\_\_\_\_\_  
Notary's signature

\_\_\_\_\_  
Residing in

\_\_\_\_\_  
My commission expires:

Notary's seal

END OF DOCUMENT

**DOCUMENT 00 62 11**  
**SUBMITTAL TRANSMITTAL FORM**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Form is self-transmittal. Letter of transmittal is not required.
- B. All submittals must be submitted utilizing the OWNERS construction management software. A link will be provided in the letter of intent to award.
- C. ENGINEER's review of submittals does not release or relieve CONTRACTOR from complying with all requirements of the Contract Documents.

**1.2 ENGINEER'S FORM**

- A. An example of the ENGINEER's form is as follows:

<b><u>SUBMITTAL REVIEW</u></b>	
<input type="checkbox"/> NO EXCEPTIONS TAKEN	<input type="checkbox"/> REJECTED
<input type="checkbox"/> MAKE CORRECTIONS NOTED	<input type="checkbox"/> RESUBMIT
<input type="checkbox"/> SUBMIT SPECIFIED ITEM	<input type="checkbox"/> DO NOT RESUBMIT
<p>This review is for general conformance with the design concepts of the Work and general compliance with the Contract Documents and does not constitute an approval or variance. Corrections or comments, or the failure to make them, on this review does not relieve the CONTRACTOR from full contract compliance.</p> <p>The CONTRACTOR is responsible for compliance with all contract provisions, dimensions, sizes, capacities, fabrication and construction techniques, installation, coordinating work with others, and performing the Work in a safe and satisfactory manner.</p> <p>Date: _____ By: _____</p> <p style="text-align: center;"><b>SALT LAKE CITY PUBLIC UTILITIES ENGINEERING</b></p>	

- B. Meaning of ENGINEER's form:

- 1. No Exceptions Taken: Submittals have been reviewed and no corrections were noted.
- 2. Make Corrections Noted: Submittals that have only minor discrepancies. Resubmission will not be required unless the stamp is marked "Resubmit".
- 3. Submit Specified Item: Submittals that are incomplete or require more than minor corrections will be annotated to indicate necessary corrections. Resubmit the part of the submittal showing the corrections.
- 4. Rejected: Submittals that are fundamentally in error, cover wrong equipment or construction, or require extensive corrections.
- 5. Resubmit: Submittals that require resubmission. Make corrections required, note any changes by dating the revisions to correspond with the change require date, and resubmit the corrected material.
- 6. Do Not Resubmit: Submittals that are not necessary to resubmit.

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SUBMITTAL TRANSMITTAL FORM				DATE		[     ] NEW SUBMITTAL [     ] RESUBMITTAL	
Section I		REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the CONTRACTOR)					
TO			FROM			TRANSMITTAL No.	
						PREVIOUS TRANSMITTAL No.	
SPECIFICATION SECTION NUMBER (See instructions)			CONTRACT TITLE			CONTRACT No.	
SUBMITTAL ITEM No.  a.	DESCRIPTION OF ITEM SUBMITTED (Type, size, model number, etc.)  b.	SAMPLE OR CERTIFICATE (See instructions)  c.	NO. OF COPIES  d.	CONTRACT REFERENCE DOCUMENT		VARIATION (See instructions)  g.	
				SPEC. PARA. No. e.	DRAWING SHEET No. f.		
REMARKS				I certify that the above submitted items have been reviewed in detail and are correct and conform with the contract Drawings and specifications except as otherwise noted.  _____ NAME AND SIGNATURE OF CONTRACTOR			

## **INSTRUCTIONS**

1. TRANSMITTAL No: Number each transmittal consecutively in the space entitled "Transmittal No.". This number will identify each submittal.
2. PREVIOUS TRANSMITTAL No: Mark the box for re-submittal and insert the transmittal number of last submission as well as the new submittal number in the spaces provided. Each re-submittal will become a new transmittal.
3. SPECIFICATION SECTION NUMBER: Cover only one specification section with each transmittal.
4. Column "a": For each entry on this form, the "SUBMITTAL ITEM No." will be the same SUBMITTAL ITEM No. indicated on the Submittal Register (Form 01 33 00).
5. Column "c": When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate".
6. Column "g": CONTRACTOR will place a check mark in the "Variation" column when a submittal is not in accordance with the plans and specifications – also, a written statement to that effect shall be included in the space provided for "Remarks" or on a separate page.
7. ENGINEER shall return a Submittal Review Response form.

END OF SECTION

**DOCUMENT 00 62 16**  
**CERTIFICATE OF INSURANCE**

**PART 1   GENERAL**

**1.1   PROCEDURE**

- A. For filing purposes, add Certificates of Insurance to the Contract Documents following this page.

END OF DOCUMENT

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## **SECTION 00 73 00**

### **SPECIAL PROVISIONS**

#### **1. WARRANTY**

- A. The following warranty conditions shall apply for all products unless otherwise modified in the individual specifications:
1. A written material warranty guarantee of **1 years** minimum shall be provided by the manufacturer against any breakdown of the material effectiveness of the structural repair elements. CONTRACTOR shall submit a warranty document certifying the material is protected against defects for the entire length of the warranty period.
  2. A written workmanship warranty guarantee of **1 years** minimum shall be provided by the CONTRACTOR against any shortcomings of the workmanship. CONTRACTOR shall submit a warranty document certifying the workmanship is protected against defects for the entire length of the warranty period.
  3. A warranty inspection may be conducted in the 11th and 35th months or anytime following the final acceptance of the work. At their option, the CONTRACTOR and a representative of the manufacturer may participate in the inspection. Inspection shall be conducted by OWNER. All deficiencies shall be repaired at CONTRACTOR 's expense in a manner mutually agreed by OWNER and CONTRACTOR.

#### **2. CONTRACTOR'S RESPONSIBILITIES**

- A. Locate and designate all existing manholes and new manhole or structure access points as necessary for the Work. Where existing manholes are to be used for installation of rehabilitation methods, enlarge existing openings into the pipe as required to install the products and provide for the removal and replacement of manhole cones, grade rings, ring and covers as required. Condition of existing manholes may require complete replacement at access points. Some manholes have been noted as offset manholes. If an offset manhole is used as an access point, the manhole shall be removed and replaced with a new manhole.
- B. OWNER or ENGINEER shall determine if condition of surrounding pipe warrants replacement. Where new structures are necessary or existing structures will be modified or otherwise disturbed, provide a stamped design and installation plan from a Professional Engineer registered in the state of Utah. Provide for installation of new or modified structures and complete restoration of all areas disturbed by CONTRACTOR operations.
- C. All manhole work including enlarging of access points, manhole repair, and new manhole installation shall be as indicated on the Drawings. All work designs, plans and proposals are to be submitted to the OWNER or ENGINEER for review and approval. All work will be in accordance with the APWA Standard Plans and Specifications and as required and approved by the OWNER or ENGINEER.
- D. The CONTRACTOR shall obtain access to water hydrants for cleaning, installation and other work items requiring water. CONTRACTOR shall comply with all connection and use requirements. The CONTRACTOR shall obtain a fire hydrant meter from Salt Lake City Public Utilities and pay a refundable one thousand dollar (\$1000.00) deposit. There shall be no charge for water used through the fire hydrant meter for the project.

- E. Provide Blue Stakes locating and marking of all existing utilities in areas where excavation is to be performed prior to beginning any excavation. CONTRACTOR to field locate and mark limits of any excavation work required. Utilities are shown on the Drawings for informational purposes only. The indication of utilities in the Drawings shall not be construed by the CONTRACTOR to mean that all utilities are shown in the Drawings, or that those shown are in the exact location.
  - F. Provide for protection of all existing facilities and restoration of all areas disturbed by the CONTRACTOR operations as specified. If utilities relocation is required, CONTRACTOR shall coordinate with utility owner to relocate utility under provisions of the Salt Lake City Utility franchise agreements.
3. **TRAFFIC CONTROL**
- A. The Contractor shall follow all traffic control guidelines as specified in the Traffic Control section.
4. **FIELD VERIFICATION OF DIMENSIONS**
- A. The manhole depths, manhole locations, and pipeline lengths indicated on the drawings are approximate. CONTRACTOR shall verify all dimensions before ordering or manufacturing any products to be used during the rehabilitation work.
5. **PHOTOGRAPHS AND DVD RECORDING**
- A. Prior to start of construction, photographs and video recording shall be taken by the Contractor where excavations or entry onto private property are required during construction to show utility crossings, installation of bypass piping, excavations, installation of lining system, and repair or construction of manholes or access structures. The Contractor shall include all existing structures, vegetation, and general conditions of the work site.
  - B. The video recording shall be high quality video .MP4 format with a minimum of 720p resolution on a digital media (flash drive or portable hard drive) formatted to be compatible with PC systems. The .MP4 file should contain an audio track that narrates the progression of the camera through the site. Photographs shall be digital (10.0 mega pixel minimum) of foundations, driveways and other areas of potential damage.
  - C. After completion of the construction and restoration, photographs and video recordings shall be taken by the CONTRACTOR from the same points in the same direction as the pre-construction examination.
  - D. video recordings and photographs shall be submitted to the OWNER or ENGINEER within seven (7) days prior to substantial completion and prior to acceptance of the work by the OWNER or ENGINEER.
6. **PRE-CONSTRUCTION SUBMITTALS**
- A. The following shall be submitted for review prior to the start of construction:
    - 1. Items listed in the individual sections.
    - 2. Access points and pit locations and dimensions, as required. Limits on locations for access points are indicated on the Drawings. Access points outside these limits shall require review and approval by the OWNER or ENGINEER for each deviated

location.

3. Access structure details, as required. Drawings shall be stamped by a Professional Engineer registered in the State of Utah and include the following:
    - a. Dimensions.
    - b. Reinforcement.
    - c. Locations.
  4. Groundwater management plan and a State of Utah groundwater permit application.
  5. Traffic Control plan submittal as specified.
  6. Safety plan with a list of hazards and mitigation methods.
  7. Quality Control and testing plan.
- B. Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. CONTRACTOR shall submit a complete initial submittal including all components. When an item consists of components from several sources, CONTRACTOR's initial submittal shall be complete including all components.
- C. All submittals, regardless of origin, shall be approved by CONTRACTOR and clearly identified with the name and number of this Contract, CONTRACTOR's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of CONTRACTOR. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on drawings and other descriptive data.
- D. CONTRACTOR shall be solely responsible for the completeness of each submittal. CONTRACTOR's stamp or affixed approval statement of a submittal, per the Submittal Transmittal Form, is a representation to OWNER or ENGINEER that CONTRACTOR accepts sole responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that CONTRACTOR has reviewed and coordinated each submittal with the requirements of the Work and the Contract Documents.
- E. All deviations from the Contract Documents shall be identified as deviations on each submittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by CONTRACTOR (including modifications to piping other facilities that may be a result of the deviation).
- F. OWNER or ENGINEER's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. OWNER or ENGINEER's review shall not relieve CONTRACTOR of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of CONTRACTOR's sole responsibility for compliance with the Contract Documents.

- H. OWNER or ENGINEER's submittal review period shall be 28 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in OWNER or ENGINEER's office. The time required to mail the submittal or resubmittal back to CONTRACTOR shall not be considered a part of the submittal review period.
- I. CONTRACTOR shall accept full responsibility for the completeness of each resubmittal. CONTRACTOR shall verify that all corrected data and additional information previously requested by OWNER or ENGINEER are provided on the resubmittal.
- J. When corrected copies are resubmitted, CONTRACTOR shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by OWNER or ENGINEER on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal

## **8. PERMITS REQUIRED**

- A. All permits required for this project will be paid at cost.
- B. Supplement the permit list given in Section 00 73 10 (6.7) to include:
  - 1. Traffic Control—Traffic Control plan approval required to get the Public Way permit.
  - 2. Noise—Issued by Salt Lake County Health Department (SLVHD), 788 E. Woodoak Lane, Murray, Utah 84107.
    - a. The requirements of the SLCoHD noise permit is built around keeping noise in residential neighborhoods no more than 10 dB(A) above ambient between 7:00 AM to 10:00 PM and no more than 5 dB(A) above ambient outside those hours (nighttime). A waiver may be applied for to work outside the SLVHD specified regular working hours of 7:00 AM to 10:00 PM.

## **9. WORKING HOURS**

- A. The working hours shall be defined as 8:00 AM to 5:00 PM, five days per week and in accordance with the noise permit requirements above.
- B. The work hours need to be controlled as much as possible to minimize disturbances to adjacent residences. The OWNER or ENGINEER may permit Work outside normal project work hours but the CONTRACTOR shall still comply with appropriate noise, safety, environmental, odor and other requirements.
- C. CONTRACTOR may conduct nighttime work as allowed under applicable permitting authority (SLVHD) and based on prior schedule approval 2-weeks in advance by OWNER or ENGINEER and subject to local neighborhood coordination. Nighttime work will be limited to times when continuous operations are required for material curing (e.g. grout, resin curing) and not for CONTRACTOR convenience. CONTRACTOR will be allowed up to, but not more than, 16 separate extended work operation periods up to 72 hours each as noted herein.

# **10. ACCESS AND USE OF THE OWNER'S SHAREPOINT WEBSITE**

1. The CONTRACTOR shall utilize the OWNER's SharePoint website for all written CONTRACTOR correspondence, submittals, transmittals, pay applications, schedule updates, or other communication where feasible. CONTRACTOR shall utilize OWNER-established SharePoint workflows as directed.
2. The CONTRACTOR shall request access to the OWNER's SharePoint website through the Project Manager, by providing the name, employer, e-mail address and phone number of each individual for which access is requested.
3. All SharePoint workflow functions require one (1) individual to be designated as the point of contact to receive workflow e-mail alerts from the system. The CONTRACTOR shall designate one individual as the point of contact for these workflows at the time access is requested. The point of contact can be changed upon the request from the CONTRACTOR at any time during the execution of the project.
4. The OWNER will determine the level of access to the SharePoint website that will be granted to each individual.
5. The OWNER and or OWNER's Representative shall provide SharePoint training to the CONTRACTOR(s).
6. The OWNER shall provide instruction sheets for the electronic workflows executed through the SharePoint site.
7. CONTRACTOR is required to have access to computer hardware and software that is compatible with the OWNER's SharePoint system, capable of running automated process workflows, and supporting electronic signatures. Minimum system requirements include:
  - a. Windows 7 or higher.
  - b. Microsoft Internet Explorer version 8 or higher (Google Chrome preferred).
  - c. Microsoft Office 2010 or higher.
  - d. Latest version of Adobe Acrobat (at a minimum Reader, Standard or Professional for editing).
  - e. Broadband internet connection.
  - f. Open access to <https://slcut.sharepoint.com>
8. CONTRACTOR shall verify current system requirements at start of contract and may need to adjust requirements during the contract period to accommodate upgrades or changes to the SLCDPU's system.

END OF SECTION

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**DOCUMENT 00 73 10**  
**MODIFICATIONS TO THE GENERAL CONDITIONS**  
(Supplementary Conditions)

This document changes provisions specified in the General Conditions (Document 00 72 00) in the Manual of Standard Specifications published by the Utah Chapter of the American Public Works Association.

Add the following paragraphs to Article 2.2

**2.2 COPIES OF DOCUMENTS**

- B. OWNER shall not furnish to CONTRACTOR published Contract Documents that include the current edition of the Manual of Standard Plans and the Manual of Standard Specifications. The CONTRACTOR shall purchase such documents separately.
- C. Copies of all Contract Documents including the current edition of the Manual of Standard Plans and the Manual of Standard Specifications shall be provided on site by the CONTRACTOR.

Modify paragraph 2.5C

**2.5 BEFORE STARTING CONSTRUCTION**

- C. Field Office: An on-site field office is not required however, CONTRACTOR shall provide and maintain a telephone in the field during performance of the Work such that ENGINEER may always contact CONTRACTOR for transmittal of Plans and instructions and, for dissemination of project information.

Modify Article 5.1

**5.1 PERFORMANCE, PAYMENT AND OTHER BONDS**

- A. Before OWNER executes the Agreement, CONTRACTOR shall file with OWNER a good and sufficient Performance Bond (using OWNER's Document 00 61 13) and a Payment Bond (using OWNER's Document 00 61 14), each in the sum of not less than 100 percent of the Contract Price.
- B. The Bonds shall be executed by CONTRACTOR and issued by a company duly and regularly authorized to do a general surety business in the State of Utah and either (i) named in the current U.S. Treasury Department's listing of approved sureties (Department Circular 570) (as amended), or (ii) with a current "A-" rating and a financial size category rating of at least a "VII" or better in A.M. Best Co., Inc.'s Best Insurance Reports, Property and Casualty Edition.
- C. The Performance Bond shall guarantee the faithful performance of the Construction Contract by CONTRACTOR and the Payment Bond shall guarantee the payment of labor and materials. The Bonds shall inure by their terms to the benefit of OWNER. Neither this nor any other provision requiring a Performance Bond shall be construed to create any rights in any third party Claimant as against OWNER for performance of the Work under the Construction Contract.

- D. If the surety on any Bond furnished by CONTRACTOR is subject to any proceeding under the Bankruptcy Code (Title 11, United States Code) or becomes insolvent or its right to do business is terminated in the State of Utah or it ceases to meet the requirements of this Article, CONTRACTOR shall, within 15 days thereafter, substitute another Bond and surety, both of which must be acceptable to OWNER.

Modify Article 5.2

## 5.2 INSURANCE

### A. In General:

1. Any insurance coverage required herein that is written on a “claims made” form rather than on an “occurrence” form shall (i) provide full prior acts coverage or have a retroactive date effective before the date of the Agreement, and (ii) be maintained for a period of at least three (3) years following the end of the term of the Agreement or contain a comparable “extended discovery” clause. Evidence of current extended discovery coverage and the purchase options available upon policy termination shall be provided to OWNER.
2. All policies of insurance shall be issued by insurance companies licensed to do business in the state of Utah and either:
  - a. Currently rated A- or better by A.M. Best Company;
  - OR-
  - b. Listed in the United States Treasury Department’s current *Listing of Approved Sureties (Department Circular 570)*, as amended.
3. CONTRACTOR shall furnish certificates of insurance, acceptable to OWNER, verifying the foregoing matters concurrent with the execution hereof and thereafter as required.
4. In the event any work is subcontracted, CONTRACTOR shall require its subcontractor, at no cost to OWNER, to secure and maintain all minimum insurance coverages required of CONTRACTOR hereunder.
5. All required certificates and policies shall provide that coverage thereunder shall not be canceled or modified without providing, in a manner approved by the OWNER’s Attorney, 30 days prior written notice to OWNER.

**B. Required Insurance Policies:** CONTRACTOR, at its own cost, shall secure and maintain during the term of this Agreement, including all renewal terms, the following minimum insurance coverage:

1. **Worker's compensation and employer's liability insurance** sufficient to cover all of CONTRACTOR’s employees pursuant to Utah law, unless a waiver of coverage is allowed and acquired pursuant to Utah law. In the event any work is subcontracted, CONTRACTOR shall require its subcontractor(s) similarly to provide worker’s compensation insurance for all of the latter’s employees, unless a waiver of coverage is allowed and acquired pursuant to Utah law.
2. **Commercial general liability (CGL) insurance with Salt Lake City Corporation as an additional insured on a primary and non-contributory basis in comparison**



**to all other insurance including OWNER's own policy or policies of insurance, in the minimum amount of \$2,000,000 per occurrence with a \$3,000,000 general aggregate and \$3,000,000 products completed operations aggregate.**

These limits can be covered either under a CGL insurance policy alone, or a combination of a CGL insurance policy and an umbrella insurance policy and/or a CGL insurance policy and an excess insurance policy. The policy shall protect OWNER, CONTRACTOR, and any subcontractor from claims for damages for personal injury, including accidental death, and from claims for property damage that may arise from Contractor's operations under this Agreement, whether performed by Contractor itself, any subcontractor, or anyone directly or indirectly employed by either of them. Such insurance shall provide coverage for premises operations, acts of independent contractors, products and completed operations.

3. **Commercial automobile liability insurance that provides coverage for owned, hired, and non-owned automobiles used in connection with this Agreement in the minimum amount of a combined single limit of \$2,000,000** or \$1,000,000 liability per person, \$2,000,000 liability per accident, and \$250,000 property damage. These limits can be reached either with a commercial automobile liability insurance policy alone, or with a combination of a commercial automobile liability insurance policy and an umbrella insurance policy and/or a commercial automobile liability insurance policy and an excess insurance policy. If the policy only covers certain vehicles or types of vehicles, such as scheduled autos or only hired and non-owned autos, Contractor shall only use those vehicles that are covered by its policy in connection with any work performed under this Agreement.

Add the following paragraphs to Article 6.7

#### **6.7 PERMITS**

- H. Salt Lake City Permits: In addition to any other permits required for the Work, CONTRACTOR shall obtain permits from Salt Lake City Corporation for Work on the Project.
  1. OWNER-Paid Permits: CONTRACTOR shall be responsible for submitting plans, scheduling inspections and paying all costs incidental to such actions as required for any permit required by Salt Lake City Corporation. Except for construction water meter fees, the fees for these permits shall be paid by OWNER and shall not be included in CONTRACTOR's bid. The following list is not exclusive and does not relieve CONTRACTOR of the responsibility of obtaining all permits.
    - a. From Salt Lake City Community & Neighborhoods Department, Division of Transportation, 349 South 200 East, Suite 450, Salt Lake City, Utah 84111. Phone 801-535-6630
      1. Parking meter bagging and removal permit
      2. Street closure permit
      3. Traffic control permit
      4. Any other applicable Division of Transportation imposed fee

- b. From Salt Lake City Department of Public Utilities, 1530 South West Temple Street, Salt Lake City, Utah 84115
  1. UPDES storm drain water discharge permit for sites 1 to 5 acres
  2. SLC SWPPP permit
  3. All applicable water, fire, sewer and storm drainage impact and connection fees
- c. From Salt Lake City Building Services and Licensing, 451 South State Street, Salt Lake City, Utah 84111. Phone 801-535-7751
  1. Building, plumbing, mechanical, electrical permit (as applicable)
- d. The CONTRACTOR or subcontractor (whichever is doing work in the public way) shall obtain from Salt Lake City Corporation Department of Community and Neighborhoods, Engineering Division, 349 South 200 East, Suite 100, Salt Lake City, Utah 84111a permit to work in the Public Way. To obtain such permit the CONTRACTOR or subcontractor, as the case may be, shall provide or have on file a \$15,000.00 bond to work in the Public Way and applicable insurance. The insurance required is the same as that required for this contract.
2. CONTRACTOR-Paid Permits: The fees for permits not paid for by OWNER shall be included in CONTRACTOR's Bid. The following list is not exclusive and does not relieve CONTRACTOR of the responsibility of obtaining all permits:
  - a. Construction Water Meter: If water for construction is required to be taken from fire hydrants or a new water meter, CONTRACTOR shall be solely responsible for obtaining and paying for such permits and water usage to Salt Lake City Corporation Department of Public Utilities permit office, 1530 South West Temple Street, Salt Lake City, Utah.
    1. Hydrant meters require a \$1,000.00 deposit (\$100.00, non-refundable). A refund will be returned to CONTRACTOR by the Department of Public Utilities if the meter and equipment is returned undamaged.
- I. Other Permits: All other permit fees required by Salt Lake County, the State of Utah, the United States of America, and any of their agencies, or by any private utility companies, shall be paid for and obtained by CONTRACTOR and included in CONTRACTOR's Bid. The following list is not exclusive and does not relieve CONTRACTOR of the responsibility of obtaining all permits:
  1. UDOT Region 2: Digging permit in a UDOT roadway right of way.
  2. Private Property Owner Permit: Written permission to use private water.
  3. Private Property Owner Permit: Written permission to store product, equipment, materials, and supplies outside of the Work site boundaries.
  4. General Permit for Storm Water Discharge (Sites greater than 1 acres): From the State of Utah, Department of Environmental Quality, Division of Water Quality, 288 North 1460 West Street. P.O. Box 144870, Salt Lake City, Utah 84114-4879. Fee varies; contact the State for a quote.

5. Flood Control Permit: From Salt Lake County, Department of Public Works, Division of Flood Control, 2001 South State Street, Salt Lake City, Utah.
6. Monument Permit: From Salt Lake County Surveyor, 2001 South State Street, Salt Lake City, Utah. Fee will be at least \$100.00 per monument and is based upon time of performance.

Modify paragraph 6.17A and add paragraph 6.17E

#### **6.17 INDEMNIFICATION**

- A. **Indemnification of OWNER:** Subject to paragraph 6.17E below, CONTRACTOR shall indemnify, save harmless, and defend OWNER, its officers and employees, from and against all losses, claims, demands, actions, damages, costs, charges, and causes of action of every kind or character, including attorney's fees, arising out of CONTRACTOR's wrongful, reckless, or negligent performance hereunder. CONTRACTOR's duty to defend OWNER shall exist regardless of whether OWNER or CONTRACTOR may ultimately be found to be liable for anyone's negligence or other conduct. If OWNER's tender of defense, based upon this indemnity provision, is rejected by CONTRACTOR, and CONTRACTOR is later found by a court of competent jurisdiction to have been required to indemnify OWNER, then in addition to any other remedies OWNER may have, CONTRACTOR shall pay OWNER's reasonable costs, expenses, and attorney's fees incurred in proving such indemnification, defending itself, or enforcing this provision. Nothing herein shall be construed to require CONTRACTOR to indemnify the indemnitee against the indemnitee's own negligence.
- E. Nothing herein shall be construed to require CONTRACTOR to indemnify OWNER, ENGINEER, or their agents or employees for any damages that are caused by or result from the fault of OWNER, ENGINEER, or their agents or employees.

Modify paragraph 7.2A

#### **7.2 COORDINATION**

- A. Coordinating Agent: OWNER has contracted with Hansen Allen & Luce, Inc. for the performance of other work on the Project at the site. The organization who will have authority and responsibility for coordination of the activities among the various prime contractors will be Hansen, Allen & Luce, Inc. OWNER shall have authority or responsibility in respect of such coordination. The authority, responsibility, and extent of such authority and responsibility provided by such coordinating agent shall be as follows.
  1. Hansen, Allen & Luce, Inc.
  2. OWNER.

### **PART 10 CHANGES IN THE WORK**

#### **10.4 CHANGE ORDERS, ALLOWANCE WORK ORDERS, AND CONSTRUCTION CHANGE DIRECTIVES**

##### **A DEFINITIONS**

1. Construction Change Directive is a signed directive by the Owner's designated representative, directing a change in Work prior to a Work Order or Change Order where there is a dispute as to the terms of the Work Order or Change Order and/or there is an urgency to proceed with the change without pricing being obtained from the Contractor at the time of the directive.
2. General Allowance shall mean the funds added to the Base Contract Price for unspecified extra or additional Work that was not foreseeable at time of the bid, but that is necessary to complete the Project as originally contemplated. The General Allowance is the Base Contract Price times a defined percentage. The use of the General Allowance shall be documented by a Work Order signed by Owner's designated representative.
3. Specific Allowances include specified items of Work generally known to be required for the Project but whose quantities and/or pricing is unknown until after the items of Work have been identified. Specific Allowances should be used only for work related to the bid items specified by the Allowance. The use of the Specific Allowances shall be documented by a Work Order signed by Owner's designated representative.
4. Work Orders are issued with an automated workflow from the Owner's Project Management System, Project Central, to the Contractor and shall authorize the Contractor to perform Work for payment from the General Allowance and Specific Allowance(s), if any, set forth in the Contract between the Owner and Contractor for the Project. The content of these Work Orders is made up of previously defined RFP's, as accepted by the Owner's designated representative (as defined in Section 01 26 00 of APWA Standard Specifications).

## **B PROCESS**

### **1. Work Orders**

- a. Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract and without notice to any surety, by Change Orders, Allowance Work Orders (both General Allowance and Specific Allowance) and Construction Change Directives. The Contract Sum and the Final Completion Date shall be adjusted accordingly, per Contract terms.
- b. Except for emergencies, a Work Order authorizing payment from the General Allowance or the Specific Allowance requires prior authorization from the Owner's designated representative before starting the work. Work Orders are issued with an automated workflow from the Owner's Project Management System, Project Central, to the Contractor.
- c. Work Order or Change Order signed by Contractor with no extension of time shall exclusively establish Contractor's contract that there shall be no time extension in connection with that Work Order or Change Order. Contractor acknowledges that any attempt to preserve a future request for a time extension due to the performance of any Work associated with a Work Order or Change Order or the cumulative effects of multiple Work Orders or Change Orders is ineffective and has no force or effect pursuant to this Contract. Except for emergencies, changes to the Final Completion Date may be made only by a signed Change Order signed

by the Owner's designated representative. Additional time associated with a General Allowance Work Order or a Specific Allowance Work Order must be processed with a change order.

- d. Work Orders and Change Orders shall use the Request for Proposal (RFP) automated workflow from the Owner's Project Central system, specified by Owner and may be initiated by either party as follows:
- e. Contractor may initiate the process by submitting a proposal, using the automated workflow, to the Owner which shall fully describe the changes sought, the reasons for the changes, and the impact, if any, on the contract Final Completion Date or Contract Sum. If the Final Completion Date will be impacted by the proposed change, Contractor shall submit a schedule highlighting the anticipated impact resulting from the proposed change. If Contractor is seeking additional payment from the General Allowance, a Specific Allowance, a Bid Item Number that comprises Contractor's Base Contract Price, or the Contract Sum, it shall submit a price proposal which identifies the basis and the net change for this proposal. Contractor shall also advise the Owner in writing the results of Contractor's technical evaluation of the proposed change stating any undesirable consequences then known or reasonably foreseeable to Contractor. The Owner shall promptly respond to the proposal, within ten (10) calendar days, after reviewing the submitted material and shall either timely process the Work Order or Change Order or request additional information, clarifications or corrections until the Work Order or Change Order has been agreed upon by both Owner and Contractor.
- f. The Owner may initiate the process, with consultation from the Engineer, by submitting a request with an automated workflow to Contractor describing the change in sufficient detail to permit evaluation and Contractor shall promptly respond (within ten (10) Calendar Days) by submitting a price and time proposal to Owner. At the same time, Contractor shall also advise the Owner of Contractor's technical evaluation of the requested change stating any undesirable consequences then known or reasonably foreseeable to Contractor. Contractor shall indicate the potential severity of impact and effect to the Contractor's schedule, Base Contract Price or Contract Sum at the time the request is initially made.
- g. Any time during the Work Order or Change Order process, the Owner may elect to issue a Construction Change Directive requiring Contractor to immediately carry out the Work as defined in the Construction Change Directive or may cancel the proposed Work Order or Change Order. The Owner shall not be liable for any costs incurred by Contractor for proceeding with the contemplated Work Order or Change Order in anticipation of an approved Work Order or Change Order from the Owner's designated representative.
- h. After the Owner's approval has been obtained, the Work Order or Change Order will be prepared by the Owner for execution by the parties. The documents shall be transmitted to Contractor for signature signifying acceptance through the automated workflow from the owner's Project Central system. The documents will

be similarly signed by the Owner. The acceptance of a Work Order or Change Order constitutes a mutual contract with respect to all extensions of time and all direct or indirect costs related to the Work Order or Change Order.

## **2. Construction Change Directives**

- a. A Construction Change Directive is a signed directive by the Owner, directing a change in Work prior to an authorized Work Order or Change Order where there is a dispute as to the terms of the Work Order or Change Order or agreement on the pricing has not been reached for the Work associated with the Work Order or Change Order. A Construction Change Directive shall be signed, using an Automated Workflow from the owner's Project Central system, by Owner's designated representative.
- b. An adjustment to the cost of the Work resulting from a Construction Change Directive shall be documented with an RFP and once accepted by the Owner's designated representative, authorized in a specific allowance work order, general allowance work order, or change order.
- c. All Construction Change Directives shall be signed first by the Owner's designated representative(s) followed by the Contractor, respectively.
- d. Upon receipt of a Construction Change Directive signed by Owner, Contractor shall promptly proceed with the Work provided in the Construction Change Directive. The Contractor will acknowledge and accept the work issued with an automated workflow within ten (10) calendar day. The Contractor shall promptly advise the Owner of disagreement with the method, if any, within ten (10) calendar days.
- e. A Construction Change Directive acknowledged and accepted by Contractor indicates the adherence of Contractor to its terms. Such contract shall be effective immediately and shall be subsequently defined by an RFP which is authorized by a Specific Allowance Work Order or General Allowance Work Order signed by Owner's designated representative authorizing payment or a signed Change Order by Owner's designated representative(s).
- f. Except as otherwise agreed by the Owner and Contractor, the method and the adjustment shall be initially determined by the Owner based on reasonable expenditures and savings of those performing the Work attributable to the Work Order or Change Order, including expenditures for design services and revisions to the Contract Documents. If the Contractor does not respond within ten (10) calendar days or disagrees with the method for adjustment, Contractor shall keep and present, in such form as Owner may prescribe, an itemized accounting together with appropriate supporting data to substantiate the accounting to the reasonable satisfaction of Owner.
- g. When the Owner and Contractor, subsequent to the issuance of a Construction Change Directive, agree concerning the adjustments to the Work, the Construction Change Directive shall be effective immediately and subsequently documented by an RFP and is authorized by the preparation and execution of an appropriate signed Specific Allowance Work Order or General Allowance Work Order by the

Owner's designated representative, or a Change Order signed by Owner's designated representative.

Modify paragraph 13.3C.3

### **13.3 TESTS AND INSPECTIONS**

C. Costs of Inspections Assessable to:

3. The cost of all inspections, tests, and approvals in addition to the above that are required by the Contract Documents shall be paid by CONTRACTOR.

Modify paragraph 13.6A

### **13.6 CORRECTION OR REMOVAL OF DEFECTIVE WORK BY CONTRACTOR**

- A. In addition to CONTRACTOR's obligations under Article 6.16, if required by ENGINEER, CONTRACTOR shall promptly, as directed, either correct all Defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by ENGINEER, remove it from the site and replace it with non-Defective Work. No rejected material, the defects of which have been subsequently corrected, shall be used in the Work unless approval in writing has been given by ENGINEER. CONTRACTOR shall bear all direct, indirect, and consequential costs of such correction or removal (including but not limited to fees and charges of OWNER, engineers, architects, and other professionals) made necessary thereby.

Modify paragraph 13.7A

### **13.7 CORRECTION PERIOD**

- A. In addition to CONTRACTOR's obligations under Article 6.16, if any portion of the Work is found to be defective within one year after the date of Substantial Completion, CONTRACTOR shall correct it or replace it with non-Defective Work. The one year correction period may be superseded by such longer period of time as prescribed in the Contract Documents or by special guarantee terms required by the Contract Documents.

Add the following paragraph to Article 13.7

### **13.7 CORRECTION PERIOD**

- E. Nothing contained in this Article 13.7 shall be construed to establish a period of limitation with respect to other obligations CONTRACTOR has under the Contract Documents, including Article 6.16. Establishment of the one year period for correction of Work as described in this Article 13.7 relates only to the specific obligation of CONTRACTOR to correct the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be enforced, nor the time within which proceedings may be commenced to establish CONTRACTOR'S liability with respect to CONTRACTOR's obligations other than specifically to correct the Work. Such times include the applicable statute of limitations or statute of repose, which may be longer than one year.

Modify Article 14.5

### **14.5 SUBSTANTIAL COMPLETION**

- A. CONTRACTOR to Certify Work is Substantially Complete: When CONTRACTOR considers the Work (or portion thereof) ready for its intended use, CONTRACTOR shall certify using the electronic workflow from SLCDPU's Project Central from the corresponding project site to ENGINEER that the Work (or portion thereof) has been completed in accordance with the Contract Documents. Contractor shall include in such written certification a list of any items not finished.

The following must be accomplished to achieve Substantial Completion:

- i. All systems and parts are tied-in/commissioned; critical equipment inspected and functioning normally
  - ii. All applicable O&M Manuals have been provided and required Owner training on equipment and systems have been completed
  - iii. All applicable required safety and security deliverables have been completed
  - iv. Updated operating maps and diagrams including redlines, and all other applicable required operational updates have been received by Owner
  - v. Punchlist developed and issued
- B. ENGINEER to Review CONTRACTOR's Certification: Within five (5) Days after ENGINEER receives CONTRACTOR certification and list of Work items not finished (punchlist), ENGINEER will issue notice via the electronic workflow agreeing the Work is Substantially Complete or via email stating reasons why the Work is not Substantially Complete.
- C. Prior to CONTRACTOR submitting their certification of Substantial Completion, ENGINEER shall conduct site walk with the CONTRACTOR. During the site walk, the punchlist items will be identified, and shortly thereafter the ENGINEER will issue the punchlist to the CONTRACTOR.
- D. OWNER's Rights: OWNER shall have the right to exclude CONTRACTOR from the Work after the date of Substantial Completion, but owner shall allow CONTRACTOR reasonable access to complete or correct items on the Punch List.

Add the following Articles to Part 16

## **PART 16 DISPUTE RESOLUTION**

### **16.2 GENERAL**

- A. Unless a decision is held by an appropriate court of law to have been procured by fraud or to be arbitrary and capricious or so grossly erroneous as necessarily to imply bad faith, any factual decision made under this dispute resolution procedure shall be final and binding in any suit or action arising under the Construction Contract, including any actions by CONTRACTOR or others against OWNER or any of OWNER's agents, consultants, or employees.
- B. Compliance by CONTRACTOR with provisions of this Part shall be a condition precedent to any legal action by CONTRACTOR or any of CONTRACTOR's Subcontractors and Suppliers against OWNER or any of OWNER's agents, consultants, or employees.



- C. The provisions of this Part shall not preclude or limit judicial review of issues of law.
- D. Ambiguities in or between Contract Documents shall be construed in favor of the OWNER.

### **16.3 DISPUTES NOT RELATED TO THE GUARANTEE OF THE WORK**

- A. Any dispute arising under the Construction Contract concerning a question of fact, not related to the guarantee of the Work (Article 13.1 of the General Conditions (Document 00 72 00)), that is not disposed of by Contract Modification shall be decided pursuant to the following procedure.
  - 1. Any decision by ENGINEER interpreting the requirements of the Contract Documents may be appealed in writing to the ENGINEER. The ENGINEER's decision, regarding that appeal shall be reduced to writing and a copy shall be mailed or otherwise furnished to CONTRACTOR within 10 days. The decision of ENGINEER shall be final and conclusive unless, within 30 days after the date of receipt of such copy, CONTRACTOR mails or otherwise furnishes to ENGINEER a written appeal to the head of OWNER's department responsible for constructing the project.
  - 2. Within 15 days from the receipt of any such appeal, the department head shall issue a decision in writing and mail or otherwise furnish a copy thereof to CONTRACTOR. The decision of the department head shall be final and conclusive unless, within 15 days from the date of receipt of such decision, the CONTRACTOR mails or otherwise furnishes to the department head a written appeal to OWNER's Committee.
  - 3. The Dispute Committee shall consist of three persons selected by the department head who are knowledgeable about the Work.
  - 4. OWNER and CONTRACTOR shall each have the opportunity to fully present its case to the Dispute Committee before the Dispute Committee's deliberation. The Dispute Committee may request any other materials or written memoranda necessary to consider the issues, and may schedule other proceedings as necessary.
  - 5. The decision of the Dispute Committee shall be rendered in writing within 15 days after the Dispute Committee's final hearing of the issue and receipt of any supplemental material requested by the Dispute Committee. The decision shall be mailed or otherwise delivered to CONTRACTOR.
  - 6. The decision of the Dispute Committee shall be the final binding interpretation of the facts that are the subject of the appeal.

### **16.4 DISPUTES RELATED TO THE GUARANTEE**

- A. Except as otherwise provided by Contract Modification, any dispute concerning a question of fact involving or arising out of the guarantee required by the Contract Documents (Article 13.1 of the General Conditions (Document 00 72 00)), that is not disposed of by Contract Modification, shall be decided pursuant to the provisions of Paragraph 16.3 above, except that the initial factual decision shall be issued in writing by the ENGINEER, together with the department head.

- B. Any appeal therefrom shall be made within 15 days directly to the Dispute Committee where such disputes shall be governed by provisions in sub-paragraphs 3 to 6 in paragraph 16.3A above.

#### **16.5 WORK DURING APPEAL**

- A. Notwithstanding the pendency of any protest or appeal provided above, CONTRACTOR shall, if so ordered by ENGINEER, proceed with the Work under the Contract Documents according to ENGINEER's direction and according to the decision on any appeal. The existence of a claim or protest shall not excuse CONTRACTOR from the requirements of the Contract Documents, including, but not limited to, the Contract Time.

#### **16.6 APPEALS OF TERMINATION OR SUSPENSION**

- A. Any decision of OWNER to terminate or suspend the Work shall not be subject to the provisions of this Part.

END OF DOCUMENT

# SECTION 00 73 15

## MODIFICATIONS TO APWA STANDARD PLANS

(Supplementary Conditions)

### PART 1 GENERAL

#### 1.1 DOCUMENT INCLUDES

- A. This Document specifies changes to the Standard Plans published by the Utah Chapter of the American Public Works Association. Not all of these modifications will apply to the Work. CONTRACTOR is to apply the appropriate modification to the appropriate Standard Plan.

#### 1.2 CHANGES

- A. Modify the standard plans as follows.

**Table 1 – WATER**

APWA Standard Plan No.	Description	Modification
381	Trench backfill	Refer to Salt Lake City Public Utility (SLCPU) - Standard Practice #1. Maximum depth for magnetic marking tape is 18 inches.
382	Pipe zone backfill	Refer to SLCPU – Standard Practice #1 and notes given in Table 3 – Storm Drain.
502	27" frame & cover	Use smooth surface "waffle" pattern class 35 lid.
511	Fire hydrant	<ul style="list-style-type: none"> <li>Move the auxiliary valve to connect to the fitting at the fire hydrant.</li> <li>If the pipe connecting to the main is greater than 16 feet, a second shutoff valve is required at the main.</li> </ul>
521	3/4" & 1" meter	No material is to be backfilled inside meter box.
522-529	Various sized meters	See SLCPU standard drawings for Contractor checklist.
543		Not used
551	3/4" & 1" service taps	<ul style="list-style-type: none"> <li>Depth of service line is 48" minimum.</li> <li>Tap will be at 10 or 2 o'clock position.</li> </ul>
552	1-1/2" & 2" service taps	<ul style="list-style-type: none"> <li>B - 2-piece cast iron valve box with lid is required.</li> <li>H – Type K–soft copper.</li> </ul>
572	Detector check valve	<ul style="list-style-type: none"> <li>Fitting D will be MJ x flange</li> <li>The extra gate valve located in the vault on the same side as the main supply pipeline is <b>not</b> required.</li> </ul>
574	Cover collar	Concrete supports required under traffic box.
575	Air release valve	Not used – refer to SLCPU drawing. Use PVC piping above air released valve

**Table 2 - SANITARY SEWER**

Standard Plan No.	Description	Modification
381	Trench backfill	Refer to SLCPU - Standard Practice #1.
382	Pipe zone backfill	Refer to SLCPU - Standard Practice #1 and notes given in Table 3 – Storm Drain.
402	30" frame & cover	<ul style="list-style-type: none"> <li>Use smooth surface "waffle" pattern class 35 lid.</li> <li>Low profile (1") rings are <b>not</b> allowed.</li> </ul>
411	Manhole	<ul style="list-style-type: none"> <li>5-foot minimum manhole diameter required.</li> <li>Eccentric manhole cones are <b>not</b> allowed.</li> <li>Lateral connections directly to the manhole are <b>not</b> allowed.</li> </ul>

		<ul style="list-style-type: none"> <li>Ramneck manhole section joint sealant and concrete grouting of manhole section joints is required.</li> <li>On precast manhole bases provide base with neoprene or rubber coupling system and stainless steel clamps</li> </ul>
412	Invert cover	<ul style="list-style-type: none"> <li>2"x4" bracing only required at manholes with pipe entering above the mainline flowline.</li> <li>Normal manholes will have the invert cover supported by the manhole "shelf".</li> </ul>
431	Sewer lateral connection	<ul style="list-style-type: none"> <li>Prior Public Utilities approval and permit required for all lateral installations.</li> <li>Salt Lake City will provide and install wye.</li> <li>24-hour notice required.</li> <li>Stainless steel straps required.</li> </ul>
432	Sewer lateral relocation	<ul style="list-style-type: none"> <li>Note 2- Salt Lake City will provide &amp; install wye.</li> <li>Material under bottom of obstruction will be loosely compacted ¾" minus well graded granular material or sand. Flowable fill not allowed.</li> </ul>
433	Pipe drop	Alternate 2- <b>not</b> used unless approved in writing by Public Utilities Chief Engineer.

**Table 3 - STORM DRAIN**

Standard Plan No.	Description	Modification
302	30" frame & cover	Use smooth surface "waffle" pattern class 35 lid.
303	44" frame & cover	Use smooth surface "waffle" pattern class 35 lid.
310	48" grate & frame	Not used
315	Catch basin	Note: CONTRACTOR to make back wall of box behind curb face opening as detailed.
316	Catch basin	Not used
320	Debris grate inlet	Not used
321	Automatic flap gate	Modify to include a clean-out box and lid over the flap gate.
361	Concrete grade rings	minimum height 6-1/2"
381	Trench backfill	Refer to SLCPU - Standard Practice #1.
382	Pipe zone backfill	<p>Refer to SLCPU - Standard Practice #1</p> <ul style="list-style-type: none"> <li>Pipe zone material will be ¾" minus material. An exception may be granted for concrete pipe being installed below the water table. In these cases, the fill material below the pipe springline may be 2 inches minus sewer rock when approved in advance by the Chief Engineer. Sewer rock is not allowed with PVC and HDPE-N12 pipe.</li> <li>In all cases, backfill in the pipe zone above springline of pipe will be Grade ¾" minus material .</li> <li>The thickness of Type B – haunch material will be 6 inches below the outside diameter of the pipe.</li> </ul>

**PART 2    PRODUCT**                      Not Used

**PART 3    EXECUTION**                      Not Used

END OF SECTION

**DOCUMENT 00 73 50**  
**REQUIREMENTS OF THE DEPARTMENT OF PUBLIC UTILITIES**  
(Supplementary Conditions)

**PART 1 GENERAL**

**1.1 DOCUMENT INCLUDES**

- A. Procedures for water line and sewer line construction.

**1.2 RELATED WORK**

- A. Salt Lake City Department of Public Utilities has published a document entitled Standard Practices for Salt Lake City Public Utilities (most current edition). The document is available from 1805 West 500 South, Salt Lake City, Utah 84104. In that publication there is a list of standard practices that apply to contractors.

1. The standard practices are as follows
  - a. Trench Backfill Requirements (No. 1).
  - b. Jordan and Salt Lake Canal Standards (No. 3).
  - c. Flushing and De-chlorination (No. 4).
  - d. Cable Installations (No. 8).
  - e. Water Service Kills (No. 9).
  - f. Commissioning Waterlines (No. 12).
  - g. Commissioning Large Service and Fire Lines (No. 13).
  - h. Hydrostatic Testing of Water Lines (No. 14).
  - i. Tree Pruning and Root Cutting (No. 15).
  - j. Raising Manholes, Cleanout and Water Valve Boxes (No. 16).
  - k. Standard Fire Hydrant Colors (No. 17).
  - l. Disinfection Large Water Connections (No. 18).
  - m. Waterline Installation in Hydrocarbon Contaminated Areas (No. 19).
2. Use the appropriate standard practice when doing work on sewer, water, and storm drain facilities that are owned by the City Department of Public Utilities.

**1.3 SUBMITTALS**

- A. Prior to final payment, submit.
1. All Contract Documents as required by Article 6.11 of Document 00 72 00 in the Manual of Standard Specifications.
  2. Water Service Work Performance Form. Use form at the end of this document.

## **PART 2 CHANGES TO THE APWA SPECIFICATIONS**

### **2.1 SECTION 33 08 00 - COMMISSIONING OF WATER UTILITIES.**

- A. Add a new paragraph to Article 1.2

#### **1.2 REFERENCES**

- C. AWWA C600, C602, and C606.

### **2.2 SECTION 33 08 00 – COMMISSIONING OF WATER UTILITIES.**

- A. Replace Article 3.6 with the following.

#### **3.6 PRESSURE TEST AND DISINFECTION**

- A. Prevent contamination from entering the line during storage, construction, or repairs. For new construction, keep a plug on the end of the pipe except for installing the next section of pipe.
- B. Disinfect the line by placing granular or tablet chlorine (10 to 25 mg/l concentration for 24 hours) in the line during installation and filling the line with water.
- C. De-chlorinate the line or dispose of chlorinated water in an acceptable manner and flush the line (see Standard practice No. 4 and the following paragraphs.
- D. Provide air release taps at pipeline's highest elevations and expel all air before test. Insert permanent plugs or air relief valves after test has been completed.
- E. Complete a hydrostatic test of the line according to AWWA for the type of pipe used (i.e. for ductile iron pipe; AWWA C600, PVC pipe AWWA C605). This will include connecting any external pump to the pipe and applying a hydrostatic pressure as established for the work by the Chief Engineer. This will be at least 200 psi at the lowest point of the line. This pressure will be maintained within 5 psi for two hours (2 hrs.) and the amount of makeup water will be measured. The amount of makeup water must be less than 1.5 gallons and 2.2 gallons per 1,000 feet of pipe for eight inch (8") and 12 inch (12") pipe respectively. No piping installation will be accepted until the leakage is less than the amount listed above.
- F. Locate and repair defective joints and retest until leakage rate is less than allowable.
- G. Repair any noticeable leakage even if the total leakage is less than allowable.
- H. Flush after hydrostatic test and let the line sit for at least 16 hours before collecting a water sample.
- I. A representative of the Chief Engineer will collect and deliver a water sample to the City laboratory.
- J. Earliest test results may be available the next day.
- K. If the test passes, a second sample will be collected by the City representative and delivered to the City laboratory.
- L. If the first sample is bad, then the line will be flushed and allowed to sit in chlorinated state for 16 hours before another sample is collected.

- M. When two (2) acceptable samples have been obtained, the line is acceptable and services can be connected.

**2.3 SECTION 33 11 00 – WATER DISTRIBUTION AND TRANSMISSION.**

- A. Add a new paragraph to Article 2.1

**2.1 PIPES AND FITTINGS**

- E. Provide Chevron fm #1 non-oxide grease and 8 mil polyethylene wrap.

- B. Add a new paragraph to Article 3.4

**3.4 INSTALLATION – PIPE AND FITTINGS**

- I. Coat all exposed nuts and bolts with Chevron fm #1 non-oxide grease and 8 mil polyethylene wrap.

**2.4 SECTION 33 13 00 – DISINFECTION.**

- A. Add a new paragraph to Article 3.2

**3.2 DISINFECTION OF WATER LINES**

- H. Refer to Article 3.6 of Section 33 08 00 – Commissioning of Water utilities as amended in Section 00 73 50.

END OF DOCUMENT

WATER SERVICE  
WORK PERFORMANCE FORM  
Department of Public Utilities  
Salt Lake City, Utah



**DOCUMENT 00 91 13**  
**ADDENDA**

**PART 1 GENERAL**

**1.1 PROCEDURE**

- A. For filing purposes, add Addenda and Modifications to the Contract Documents following this page.
- B. All official Addenda and Modifications will be labeled, DOCUMENT 00 91 13.X, ADDENDUM NO. X

Any other document will not be considered as an Addendum for purposes of acknowledgement.

END OF DOCUMENT

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## **SECTION 01 11 00**

### **SUMMARY OF WORK**

#### **PART 1 GENERAL**

##### **1.1 WORK COVERED BY CONTRACT DOCUMENTS**

- A. Work of this Construction Contract comprises but not limited to:

The construction of a drinking water pump station facility. The pump station will be a masonry block building with standing seam metal roof equipped with five (5) vertical turbine drinking water pumps, motors and pump cans; exposed suction manifold piping inside an attached valve pit; valves, flow meter, and miscellaneous fittings and appurtenances; discharge pipelines connecting to existing distribution system; two bladder-style surge tanks; free standing 1 ton workstation crane; installation of a new gas-powered back-up generator and new natural gas connection and meter; storm drain and floor drain structures and piping; and HVAC system. Electrical work will include installation of a new power pole, buried power conduit, transformer, buried conduits for electrical connections; panels, including five (5) VFD panels; light poles and conduits for future security system; and electrical work associated with the booster pump station, and control wiring for system PLCs. RTU to be furnished by Owner. Site preparation will include excavation of unsuitable foundation material, backfill and compaction of approved material, forming and placement of concrete for footings, foundation walls, and floor slabs. Other site work will include clearing, grubbing, stripping and erosion control measures; asphalt surface placement and grading, concrete sidewalk; chain link and ornamental fencing, motorized access gate; temporary trail relocation; traffic control; and rock surface landscaping.

In conjunction with the construction of the new pump station, new valve vaults will be constructed to improve connections to the Morris Reservoir at the inlet and outlet. These connections are crucial to the functioning of the new pump station. Additional improvements are planned along the existing 18-inch City Creek Water Treatment Plant transmission pipeline from the air valve at the high point down to 18<sup>th</sup> Ave. Other valve vault improvements will be constructed near the Ensign Downs Low Tank. These include replacing a butterfly valve in the tank valve vault and constructing a new hydraulic control valve vault near Oak Forest Road and Capitol Oaks Lane.

Upon successful completion, commissioning and testing of new facilities the existing pump station will be decommissioned and components inside the building will be demolished/salvaged and removed, and the space will be renovated according to the Contract Drawings. Renovations will include slip lining the existing sewer lateral to 18<sup>th</sup> Ave.

The location of the work is:

925 North Hilltop Road, Salt Lake City, UT 84103

- B. The construction contract for this pump station is being administered by Salt Lake City and the water mains and all appurtenances are subject to Salt Lake City Standards. All water shut downs shall be coordinated through Salt Lake City Department of Public Utilities.

##### **1.2 CONTRACT METHOD**

- A. Construct the Work under a single unit price contract.

### **1.3 COORDINATION WITH PROPERTY OWNERS – PUBLIC RELATIONS PLAN**

- A. Maintaining good public relations with property owners and residents that use the streets affected by construction is an important component of this project. In order to maintain good public relations the CONTRACTOR shall prepare and employ a public relations plan. A written copy of the plan shall be prepared and presented to the OWNER for approval at the pre-construction conference and shall address the following minimum requirements.
1. The CONTRACTOR shall provide a Public Relations Supervisor. The Public Relations Supervisor shall be responsible for interfacing with the public throughout the project and resolving complaints and concerns of property owners adjacent to the work. The name and resume of the proposed Public Relations Supervisor shall be presented to the ENGINEER at the pre-construction conference for approval. The Public Relations Supervisor shall:
    - a. have a 24-hour access phone number to respond to complaints.
    - b. have the authority to direct the work as required to resolve concerns and complaints;
    - c. provide an updated progress schedule to the ENGINEER on a weekly basis;
    - d. ensure all notification to adjacent property owners are made as described in the contract documents;
    - e. within 60 minutes of being notified, contact any property owners who have called with complaints or expressed concerns;
    - f. resolve all complaints and expressed concerns within 24 hours;
    - g. follow-up with individuals or entities making complaints 24 hours after resolution to ensure satisfactory results are obtained;
    - h. document all complaints in a public relations log, including name, address and contact information of individual or entity, date and time of initial notification, nature of complaint, actions taken to resolve the complaint, date and time of complaint resolution, and date and time of follow-up actions; and
    - i. provide a weekly copy of the public relations log to the ENGINEER of all complaints and actions taken to resolve them;
    - j. be listed with name and phone number on all project flyers, notifications, and project signs.
  2. The CONTRACTOR shall provide a professionally prepared, movable temporary project sign as outlined in Section 01 58 00, Project Identification and Signs at the work location of the project.

**PART 2 PRODUCTS** (Not Used)

**PART 3 EXECUTION** (Not Used)

END OF SECTION

## SECTION 01 31 13

### COORDINATION

This specification changes a portion of APWA Standard Specification Section 01 31 13. All other provisions of the Section remain in full force and effect.

Add the following paragraph to Article 1.5 (page 100):

#### 1.5 COORDINATION WITH ADJACENT PROPERTY OWNER

- F. 14-days prior to beginning work in any area and once each month during construction, hand deliver a written "**Construction Status Update Notice**" to all residents, businesses, schools and property owners adjacent to and affected by the Work. Notice shall be based on the template provided by the ENGINEER and be secured to door knob should occupants not be home. Obtain ENGINEER's final review of notice and distribution list/map prior to distribution. As a minimum the notice shall contain the following:
1. name and phone number of CONTRACTOR's representative for the project;
  2. name and phone number of Public Relations Supervisor
  3. name and phone number of OWNER's project manager
  4. work anticipated for the next 30 days including work locations and work by subcontractors and utility companies;
  5. rough estimate of construction schedule through end of work affecting area;
  6. anticipated impact to driveway approach access and closures;
  7. anticipated water, sewer or power outages;
  8. anticipated vehicular traffic impacts, rerouting or lane closures;
  9. anticipated pedestrian impacts and sidewalk closures;
  10. changes to public transportation bus routes; and
  11. any other construction or work items which will impact or restrict the normal use of streets and amenities.

Failure to comply with this contract provision is considered grounds for project suspension per Article 15.1 of the General Conditions (APWA Document 00 72 00, page 71).

- G. CONTRACTOR shall notify all businesses affected by water shutdowns 72-hours in advance of the shutdown
- H. CONTRACTOR shall notify all residents affected by water shutdowns 48-hours in advance of the shutdown.
1. In order to foster good public relations, it is anticipated that several neighborhood meetings will be held between the notice of award and commencement of work. The purpose of the meeting will be to explain the purpose of the project to local residents, outline necessary closures and restrictions, and answer any questions the resident's may have. The CONTRACTOR shall attend each of the meetings and be prepared to explain the work schedule to be followed, anticipated closures, notifications, emergency contact

numbers and respond to questions from those attending.

Add the following Article to Part 1 (page 100):

#### 1.8 **PUBLIC AGENCIES AND UTILITY PERSONNEL TO CONTACT**

- A. Utility Companies: Utility companies generally require a minimum of 48 hours notice if their utility requires location, relocation or protection. Contact the following individuals to coordinate. (Please note Contractor must contact **Blue Stakes** before digging, phone **(801) 208-2100**.)
1. Enbridge Gas Company: Jason McGee, Design: phone (801) 324-3640, email Jason.mcgee@questar.com; Craig Johnson, North of 3900 South (Salt Lake City Area) – (801) 324-3841; Wade Homer, West of Redwood Road and South of 2100 South – (801) 324-3339; Michael “Rudy” Bryant, South of 3900 South – 801-324-3375. Call 2 weeks prior to requiring Enbridge work on gas mains and 1 week on service lines to property owners. An Enbridge representative must be present at the pre-construction meeting and when working around high pressure gas mains.
  2. Rocky Mountain Power Company:
    - a. Blake Ashcroft, Estimator: phone (801) 220-7254, email blake.ashcroft@rockymountainpower.net
    - b. Work Order #7199239
  3. Qwest CenturyLink:
    - a. Jeff Stapley: office (801) 974-8505; fax (801) 974-8192
    - b. Darren Keller: (801) 356-6975
    - c. Deanne Powell: (801) 974-8165
  4. The Salt Lake City Department of Public Utilities: Tamara Wambeam, G.I.S. & IT Manager, (801) 483-6746 – Mapping Questions
  5. The Salt Lake City Department of Public Utilities to schedule inspection and survey of project of installed sanitary sewer mains, storm drain mains, street lighting and water mains prior to backfilling fittings, valves, washouts, etc.: Call (801) 483-6727.
  6. The Salt Lake City Department of Public Utilities Industrial Storm Program Coordinator, Greg Archuleta, (801) 483-6821
  7. The Salt Lake City Department of Public Utilities Street Lighting Program Manager, David Pearson, (801) 483-6738
  8. AT&T: Ken Howcroft, (801) 580-8005
  9. Comcast (Cable TV): Gary Goldstein, (801) 401-3041; Kent Johnson (801) 401-3039; Eric Patten eric\_patten@cable.comcast.com; (801) 255-2711
  10. Integra Telecom, Inc., (801) 924-3000; (801) 265-0928
  11. Questar Infocomm, Inc.: Jeff Jerabek, (801) 324-1942
  12. XO Communications:
- B. Salt Lake County Engineering Division: (385) 468-6600
- C. Salt Lake County Public Works Operations Division: Kevin Smeltzer (385) 468-6124;

Brandon Johnson cell, (801) 557-9699; email [brjohnson@slco.org](mailto:brjohnson@slco.org) a minimum of 48 hour prior to:

1. Setting traffic barricades.
  2. Removal and relocation of traffic regulation, information signs and all striping modifications
- D. Salt Lake County Flood Control, Bonnie McCallister, [BMcCallister@slco.org](mailto:BMcCallister@slco.org) (385) 468-6626
- E. Emergency Services
1. All affected emergency services shall be notified 48-hours prior to any street closures and/or water main work.
    - a. Unified Police Department of Greater Salt Lake (801) 743-7000
    - b. Valley Emergency Call Center (VECC), phone (801) 840-4000 for Police, Fire, and Medical for Cottonwood Height City
    - c. Salt Lake City Public Safety Division:
      - i. Fire: Dispatch, (801) 799-3668
      - ii. Police: Dispatch, (801) 799-3000
- F. Salt Lake County Health Noise Ordinance – Sanitation and Safety, (385) 468-3835
- G. State of Utah (UDOT), Region 2 – Shane Safford, Encroachment and Permits Officer, (801) 975-4809, email [lsafford@utah.gov](mailto:lsafford@utah.gov), (801) 975-4979 fax.
- H. Utah Transit Authority: Dispatch, phone (801) 287-3202. UTA generally requires 72 hours notice if it becomes necessary to move bus stops or make scheduling changes
- I. Salt Lake City Urban Forestry: (801) 972-7818, a minimum of 72 hours prior to removing trees.
- J. Salt Lake City Transportation Division: Mr. Scott Vaterlaus, (801) 535-6630, a minimum of 48 hours prior to:
1. Setting traffic barricades.
  2. Removal and relocation of traffic regulation and information signs.
- K. Salt Lake City Traffic Signal: Cabot Jennings, (801) 535-6994; (801) 910-5720, a minimum of 48 hours prior to have Traffic Detector Loops marked.
- L. Salt Lake City, City Engineer, (801) 535-6248, a minimum of 48 hours prior to street closure.
- M. Salt Lake City Department of Airports Badging Office: (801) 575-2423 or [badginoffice@slcgov.com](mailto:badginoffice@slcgov.com).
1. For information concerning badging requirements for working on the Salt Lake International Airport property.
- N. Chevron Pipe Line Company: Concerning location and crossing crude oil lines.
1. Melissa Horiuchi, Conflict Inquiry Coordinator, Salt Lake Station, 801-539-7285
  2. Don Bristol, Facility Inspector, office 801-539-7189; cell 801-598-6131

END OF SECTION

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## SECTION 01 32 17

### BASELINE AND PROGRESS SCHEDULES

#### PART 1 GENERAL

##### 1.1 PURPOSE

- A. The OWNER is committed to delivering quality, cost-effective infrastructure to its customers in a timely manner. One of the most important tools the OWNER uses to achieve this goal is accurate, updated, current schedules for its capital projects. Accurate and updated schedules allow the OWNER to effectively track and manage its projects both in aggregate (at the program or OWNER-wide level) and project-by-project.
- B. The OWNER's goal is to take every reasonable step to ensure that projects finish on time and within budget. Project schedules are the fundamental building blocks to planning and executing projects efficiently and on time. These schedules are best prepared by those closest to the work. Because the vast majority of capital project delivery at the OWNER is performed by CONTRACTOR, it is critical that CONTRACTOR prepare schedules as part of performing their work for the OWNER.
- C. This Schedule Guidance Document is designed to guide CONTRACTOR in preparing and submitting acceptable schedules for use by the OWNER.

##### 1.2 APPLICABILITY AND BASIC REQUIREMENTS

- A. CONTRACTOR is responsible for preparing schedules as defined herein and as required in their contracts. A waiver allowing a CONTRACTOR not to prepare a schedule in accordance with this Schedule Guidance Document may only be granted by the OWNER or designee.

There are three (3) basic elements to schedule submittals.

- 1. **Baseline Schedule:** Initial schedule submitted before work begins that will serve as the baseline for measuring progress and departures from the schedule. The Baseline Schedule is prepared by the CONTRACTOR at the beginning of the project and submitted to the OWNER for review and approval.
  - 2. **Progress Schedule:** Monthly submittal of a Progress Schedule documenting progress on the project and any changes anticipated. The Progress Schedule is prepared monthly by the CONTRACTOR and submitted to the OWNER.
  - 3. **Schedule Narrative:** Concise narrative that highlights changes in the schedule, expected delays, key schedule issues, etc., along with a cash flow graph or summary table. The Schedule Narrative is submitted to the OWNER monthly in conjunction with the Progress Schedule.
- B. The schedules required herein will be prepared using the following software (or saved down in the following version) in order to be compatible with the OWNER's schedule system, unless prior permission to use another software is requested and granted by the OWNER.
    - a. Primavera Project Planner (now owned by Oracle) version 8.2 or later
    - b. or Microsoft Project.

### 1.3 BASELINE SCHEDULE

A. General: The CONTRACTOR will develop a cost loaded schedule using the software version required in Section 1.2 and the Critical Path Method (CPM).

1. The OWNER will inform the CONTRACTOR of the Project Code (Project Number) for the Project. The file naming convention is demonstrated in the examples below.

- Baseline

Format. ProjectCode (project number)\_DocumentType\_Date\_

Example. 1701\_ScheduleBaseline\_03162017.XER

- Monthly Update

Format. ProjectCode (project number)\_DocumentType\_Date\_

Example. 1701\_ScheduleUpdate\_03162017.XER

- Monthly Schedule Narrative

Format. ProjectCode (project number)\_DocumentType\_Date\_

Example. 1701\_ScheduleNarrative\_03162017.DOC

2. The approved Baseline Schedule is a part of the contract by reference. The CONTRACTOR has the sole responsibility to correct any latent defects in the Baseline Schedule and perform to the subsequently revised schedule.

3. The CONTRACTOR will use the Baseline Schedule to coordinate and monitor the work (including the activities of subcontractors, equipment vendors and suppliers).

4. The CONTRACTOR must keep a copy of the approved Baseline Schedule.

B. Schedule Work Breakdown Structure and Activities

1. **Work Breakdown Structure (WBS):** The OWNER's Work Breakdown Structure is designed to meet the basic reporting needs for the OWNER's financial and tracking systems. The CONTRACTOR's project-specific WBS should work within this basic framework and provide additional detail to efficiently deliver and track the work.

WBS elements that are definitely not a part of the scope of services need not be included in the schedule. Note that as many subtasks and activities as desired may be included underneath the WBS elements.

2. **Activities:** Activities are the discrete elements of work that make up the schedule. They should be organized underneath the umbrella of the WBS as described in Exhibit A.

The following information should be provided for each activity:

- a. Activity ID Number

- Use a four-digit number left justified in the activity I.D. field.
- Alphanumeric activity numbers are NOT acceptable.

- b. Activity Description

- Activity descriptions should adequately describe the activity and in some cases the extent of the activity. Examples of acceptable descriptions might include “install pipeline between Avenue A and Avenue B”, “water line route layout”, etc.).

**c. Activity Durations**

- The activity duration will be based upon the physical amount of work that is to be performed for the stated activity and are limited to 20 working days. If work is to exceed 20 days, then break the work down so the work will be completed within a 20-day time frame.
- The intent of this requirement is to ensure that the activities are segmented sufficiently to adequately track progress.

**d. Activity Start and Finish Dates**

- Activity start and finish dates will only be accepted if calculated by the software.
- Actual activity start and finish dates may not be assigned in a baseline. However, they must accurately be assigned in the working version of the schedule (see Section 4 Progress Schedule).

**e. Activity Dependencies**

All activities will be logically tied with a predecessor and a successor. The only exception to this rule will be for the project start and project finish milestones.

**f. Milestone Activities**

- The following milestone activities (i.e., important events on a project that mark critical points in time) are of particular interest to the OWNER and should be reflected in the Project Schedule for all phases of work, as applicable. Notice to Proceed (Construction)
- Draft Baseline Schedule submittal
- Preparation and submission of shop drawings, submittals, and any required re-submittals (if applicable)
- Mobilization
- Fabrication and delivery of equipment and materials (if applicable)
- Substantial Completion
- Construction Complete

**C. Baseline Schedule Development:** The CONTRACTOR will designate an authorized representative (Project Scheduler) responsible for developing and updating the schedule and preparing reports. It is recommended that a qualified scheduler develop the Baseline Schedule.

The CONTRACTOR’s initial schedule submittal will contain NO progress and represent the planned work for the duration of the project. Once approved by the OWNER, this schedule will become the baseline against which all future variance analysis will be performed.

The use of activity external constraint dates and lags on relationships is discouraged unless specified or approved by the OWNER. An example of an external constraint date is

“concrete placement will begin no later than January 1.” The reason for this requirement is that it creates an artificial (rather than calculated) critical path.

The Baseline Schedule will consider delivery lead times, construction and access constraints and the coordination of construction with OWNER operations.

1. **Safety Requirements:** Schedule performance should never take precedence over safety. Project schedules must allow work to be performed in a safe manner. The CONTRACTOR cannot reduce safety or worker protection in order to shorten schedules, recover lost time or accelerate the work.
2. **Inclement Weather:** Refer to climatology data for anticipating work that can be affected by inclement weather. Historical rain days can be reviewed from the following web site: <http://www.noaa.gov/climate>

- D. Changes to Approved Baseline Schedule:** The approved Baseline Schedule is the basis for measuring progress on the project (see Paragraph 1.4, Progress Schedule). As such, the CONTRACTOR should develop the Baseline Schedule considering the realistic delivery of the work tasks and likely constraints.

Total and free float is not for the exclusive use or benefit of either the OWNER or the CONTRACTOR, but is a resource available to both parties for the benefit of the project on a first needed basis. Changes to the Baseline Schedule will only be considered after all float has been consumed.

Changes to the approved Baseline Schedule may only be considered under limited circumstances. If warranted, any changes will require PRIOR approval by the ENGINEER’s Designee and OWNER’s Program Manager. Project circumstances that could be considered by the OWNER as potentially warranting re-baselining include the following:

- Change Orders to the contract affecting the scope of the work to be performed and the associated schedule completion date

#### 1.4 **PROGRESS SCHEDULE**

As described in Paragraph 1.3, the Baseline Schedule is used to coordinate and monitor the work. The CONTRACTOR is required to keep a copy of the approved Baseline Schedule.

The Progress Schedule is simply a copy of the approved Baseline Schedule that will be statused monthly. In other words, progress on the project will be shown monthly as an update of the schedule that will be compared to the approved Baseline Schedule.

Note that the Progress Schedule will be statused (data date) through month end, although the submittal date must comply with Paragraph 1.6 of this section.

- A. Progress Updates:** The CONTRACTOR should show on the Progress Schedule updates of the following:

- The actual dates that activities start
- The actual dates that activities finish
- The remaining duration of activities in progress
- The percent complete of all activities on the schedule (0 percent to 100 percent complete)

**B. Schedule Narrative:** The Progress Schedule will be accompanied monthly by a concise Schedule Narrative that explains the submitted schedule. The purpose of the Schedule Narrative is to:

- Speed review time
- Explain variances from Baseline on critical path activities
- Explain to the OWNER logic changes and potential schedule conflicts related to dependences.
- Concisely summarize the projected cash flow for the project based on the statused schedule.

If the project is on schedule, and no significant issues related to schedule exist, then the Schedule Narrative is extremely brief. On the other hand, if the project is falling behind, and/or there are significant conflicts and obstacles to meeting the Baseline Schedule, then the Schedule Narrative should describe the issues and what steps will be necessary for the project to recover. Sharing this information ensures that the entire project team will be aware of the issues and have opportunity to assist, where applicable.

## 1.5 ADDITIONAL GUIDANCE APPLICABLE TO CONSTRUCTION SCHEDULES ONLY

In addition to the requirements in Sections 1.1 – 1.4 of this Schedule Guidance Document, the CONTRACTOR's schedule will include the following.

**A. Schedule of Value Pay Items:** Schedule of Values Pay Items (Work) shall be loaded into the scheduling software using the labor, materials, and equipment resource types showing the quantity of Work to be done along with the corresponding value of the Work measured in dollars.

## 1.6 SUBMITTAL OF SCHEDULES

**A. Submittal File Formats:** Every time that a schedule or report is submitted (baseline and monthly progress) the following file formats are required.

1. **Baseline Schedule:** Submit the schedule in native file format (see below).

Also submit a .pdf of the bar chart schedule consisting of the following columns:

- Activity ID
- Activity Name
- Duration
- Start Date
- Finish Date
- Float
- Cost

2. **Progress Schedule:** Submit the schedule in native file format (see below).

Also submit a .pdf of the bar chart schedule consisting of the following columns:

- Activity ID
- Activity Name
- Physical Percent Complete
- Duration

- Start Date
  - Finish Date
  - Total Float
  - Remaining Total Cost
3. **Schedule Narrative:** Submit the schedule narrative in .doc format.
  4. **Native Schedule File Formats:** The native file structure is to save the schedule as follows:
    - a. In Primavera 6, save the file as an .XER file.
    - b. In Microsoft Project, save the file as an .MPP file.
- B. **Submittal Process:** All submittals of schedules must be made to the ENGINEER's Designee. Draft project Baseline Schedules must be submitted within thirty (30) calendar days after the formal Notice to Proceed from the OWNER. All schedules must be submitted in their native format (.XER file or .MPP) as well as in a PDF format. The OWNER will review, accept or reject the schedule within five (5) days of submittal. Once the Baseline Schedule has been accepted, Progress Schedule updates will be due monthly prior to the monthly progress meetings.

END OF SECTION

## EXHIBIT A – OWNER WORK BREAKDOWN STRUCTURE

WBS shown in gray are reserved for the OWNER. WBS shown in blue are reserved for CONTRACTOR.

WBS Number	Name
<b>1</b>	<b>Pre-Design</b>
1.1	Project Planning & Development
1.2	Design Consultant Procurement
1.3	RFP Development
1.3.1	OWNER Review Process & Consultant Negotiations
1.3.2	Consultant Selection
<b>2</b>	<b>Project Design</b>
2.1	Survey and Geotechnical
2.2	Design
2.2.1	30% Design
2.2.2	60% Design
2.2.3	90% Design
2.3	Bid Documents
<b>3</b>	<b>Bidding</b>
3.1	Bid & Award
<b>4</b>	<b>Contract</b>
4.1	Contract Negotiation
<b>5</b>	<b>Project Construction</b>
5.1	Mobilization
5.2	Construction
5.2.1	Task 1
5.2.2	Task 2
5.2.3	Task 3
5.2.4	Task 4
5.2.5	Task 5
5.2.6	Task 6
5.2.7	Task 7
5.2.8	Task 8
5.2.9	Task 9
5.2.10	Task 10
5.3	Testing and Commissioning
5.4	Construction Services
<b>6</b>	<b>Closeout</b>
6.1	Closeout

## **EXHIBIT B – EXAMPLE SCHEDULES**



## SECTION 01 33 00

### SUBMITTAL PROCEDURE

This specification changes a portion of APWA Standard Specification Section 01 33 00. All other provisions of the Section remain in full force and effect. See Section 01 33 01 for additional requirements.

Add the following article to Part 1.

#### 1.8 PROCEDURE

- A. Transmit submittals to ENGINEER through SLCDPU Engineering's Project Central SharePoint site. Access and use instructions are provided at the end of this section.

#### 1.9 SUBMITTAL REGISTER

- A. List submittals required by Contract Documents on the attached Submittal Register form. Identify CONTRACTOR's need dates and ENGINEER's action dates.
- B. The following list identifies required submittal due dates. Submittals not identified in the list but specified in the Standard Specifications shall be submitted for information only.

When Due	Section Reference	Submittal	Responsible
Pre-construction conference	01 33 00	Submittal Register	
	00 72 00	Preliminary Progress Schedule	
	00 72 00	Mobilization Plan	
	00 72 00	Safety and Protection Plan	
	00 72 00	Quality Control Program	
Prior to Starting Work	00 73 10	Permits for Work	
	01 55 26	Traffic Control Plan	
	01 57 00	Storm Water Pollution Prevention Plan	
	01 71 23	Surveyor's Name, Certificate of Assurance, License Number, Schedule of Values.	
Prior to Use	00 73 10	Written Permission to use Private Citizen's Property and Water	
Prior to Delivery On Site	32 11 23	Target Gradation Curve Crushed Aggregate	

<b>When Due</b>	<b>Section Reference</b>	<b>Submittal</b>	<b>Responsible</b>
Prior to Delivery On Site			
Upon Delivery to Site			
Prior to Water Line Use			
Prior to System Use			
Prior to 1st Concrete Placement			
Daily as applicable			
With Each Monthly Pay Request	01 32 16	Progress Schedule, Survey Schedule of Values	
5 Working Days Prior to Substantial Completion	01 78 50	Certification of Compliance and Request for Final Inspection	
Prior to Final Payment	01 78 50	Evidence of Payment to Suppliers and Sub-contractors	

**NOTES:**

1. Section references listed in this table that are not found in the Project Manual may be found in the APWA Standard Specifications.

END OF SECTION

<b>SUBMITTAL REGISTER</b>				PROJECT TITLE: _____																	
				LOCATION: _____																	
				CONTRACTOR: _____																	
SCHEDULED ACTIVITY	SUBMITTAL ITEM No.	SPECIFICATION PARAGRAPH No.	DESCRIPTION OF MATERIAL	TYPE OF SUBMITTAL										REVIEW ACTION	CONTRACTOR NEED DATES			ENGINEER ACTION DATES		OTHER	
				SAMPLES	SHOP DRAWINGS	PARTS LIST	PRODUCT DATA	DESIGN DATA	SPECIFICATION	CERTIFICATIONS	INSTRUCTIONS	O&M MANUAL	OTHER	REVIEW REQUIRED BY	SUBMITTAL DATE	APPROVAL NEEDED BY	MATERIAL NEEDED BY	DATE RECEIVED	ACTION CODE		

## **INSTRUCTIONS**

### **GENERAL**

1. CONTRACTOR to complete electronic SLCDPU Project Central Submittal Form: Review the Contract Documents to insure completeness. Expand general category listings. Show individual entries on this form for each item. Attach each item properly labeled.
  - a. As an example, a general category would be "Plumbing Fixtures" which the CONTRACTOR is to breakdown into individual entries such as "Toilet P-1, Lavatory P-2, etc.". Complete the Submittal Register, and submit it to ENGINEER.
2. Resubmittals: If a submittal is returned for correction, create a new Submittal workflow and reference the original SR ID number in the description and include the submittal register number. Do not amend the data already contained on the Submittal Register.

### **SUBMITTAL REGISTER**

1. SCHEDULED ACTIVITY: If an activity on the Progress Schedule is assigned to the submittal, place the schedule activity number in the "SCHEDULED ACTIVITY" column.
2. SUBMITTAL ITEM No.: Assign to each entry on the Submittal Register a sequential number in the "SUBMITTAL IDENTIFICATION (ITEM NUMBER)" column.
3. REVIEW ACTION: The "REVIEW ACTION" column identifies technical review responsibility of submittal. Review of all products and materials is the CONTRACTOR's responsibility; however, certain specified submittals will also require ENGINEER's review.
  - a. If REVIEW ACTION Column is Blank: Identified submittal shall be approved by the CONTRACTOR and then submitted to the ENGINEER for information.
  - b. If the "ENGINEER" is Identified in the REVIEW ACTION Column: Identified submittals shall be first approved by the CONTRACTOR and then submitted to the ENGINEER for review.
4. ENGINEER ACTION DATES: This column is for ENGINEER's use to record date submittal was received and the action code assigned in the submittal review process.
5. Upload the Submittal Register to the SLCDPU Project Central site

### **ACCESS AND USE OF THE OWNER'S SHAREPOINT WEBSITE**

9. The CONTRACTOR shall utilize the OWNER's SharePoint website for all written CONTRACTOR correspondence, submittals, transmittals, pay

applications, schedule updates or other communication where feasible.  
CONTRACTOR shall utilize OWNER-established SharePoint workflows as directed.

10. The CONTRACTOR shall request access to the OWNER's SharePoint website through the Project Manager, by providing the name, employer, e-mail address and phone number of each individual for which access is requested.
11. All SharePoint workflow functions require one (1) individual to be designated as the point of contact to receive workflow e-mail alerts from the system. The CONTRACTOR shall designate one individual as the point of contact for these workflows at the time access is requested. The point of contact can be changed upon the request from the CONTRACTOR at any time during the execution of the project.
12. The OWNER will determine the level of access to the SharePoint website that will be granted to each individual.
13. The OWNER and or OWNER's Representative shall provide SharePoint training to the CONTRACTOR(s).
14. The OWNER shall provide instruction sheets for the electronic workflows executed through the SharePoint site.
15. CONTRACTOR is required to have access to computer hardware and software that is compatible with the OWNER's SharePoint system, capable of running automated process workflows, and supporting electronic signatures. Minimum system requirements include:
  - g. Windows 7 or higher.
  - h. Microsoft Internet Explorer version 8 or higher (Google Chrome preferred).
  - i. Microsoft Office 2010 or higher.
  - j. Latest version of Adobe Acrobat (at a minimum Reader, Standard or Professional for editing).
  - k. Broadband internet connection.
  - l. Open access to <https://slcut.sharepoint.com>
16. CONTRACTOR shall verify current system requirements at start of contract and may need to adjust requirements during the contract period to accommodate upgrades or changes to the SLCDPU's system.

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**DOCUMENT 01 35 24**  
**CONTRACTORS CERTIFICATION OF**  
**COMPLIANCE TO SAFETY PLAN**

**PART 1    GENERAL**

**1.1   CONTRACTORS CERTIFICATION**

1. The Contractor will certify that they will comply with the Safety and Protection Plan requirements of the City. A letter from the Contractor describing the hazards present on this project and their plan to mitigate those hazards is attached following this page.

END OF DOCUMENT

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## **SECTION 01 45 00**

### **QUALITY CONTROL**

This specification changes a portion of APWA Standard Specification Section 01 45 00. All other provisions of the Section remain in full force and effect.

Add the following Article to Part 1.

#### **1.8 QUALITY CONTROL PROGRAM**

- A. Quality Control Program:** Provide a quality control program which includes procedures and organization so equipment, workmanship, fabrication, construction, operations, and inspections comply with the Contract Documents.
- B. Quality Control Program Manager Qualifications:**
  - 1. Not CONTRACTOR's work or site superintendent.
  - 2. Quality control experience with projects of similar type and magnitude.
  - 3. Authorized as CONTRACTOR's representative for all quality control and quality assurance matters.
- C. Quality Control Program Manager Responsibilities:**
  - 1. Manage and supervise quality control plan and quality control surveillance personnel.
  - 2. Verify that testing procedures comply with contract requirements.
  - 3. Verify that facilities and testing equipment are available and comply with testing standards.
  - 4. Check test instrument calibration data against certified standards.
  - 5. Verify that recording forms, including all the documentation requirements, have been prepared.
  - 6. Prepare copies of each test result with all necessary data recorded and with documentation and computations compiled.
  - 7. Provide more testing, if, in ENGINEER's opinion, work is not being adequately controlled.
  - 8. Immediately report any non-compliance of materials and mixes to ENGINEER and CONTRACTOR.
  - 9. When an out-of-tolerance condition exists, perform additional control testing until tolerance is attained.
  - 10. Correlate CONTRACTOR's assurance testing program (APWA Section 01 43 00) with ENGINEER's acceptance testing program (APWA Section 01 45 00).

END OF SECTION

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## **SECTION 01 55 26**

### **TRAFFIC CONTROL**

This specification changes a portion of APWA Standard Specification Section 01 55 26. All other provisions of the Section remain in full force and effect.

Change paragraph 1.2 D. to read as follows.

#### **1.2 REFERENCES**

- D. Manual on Uniform Traffic Control Devices for Streets and Highways published by the American Traffic Safety Services Association (ATSSA), 15 Riverside Parkway, Suite 100, Fredericksburg, Virginia, 22406-1717, U.S. Department of Transportation Federal Highway Administration, 2009 Edition of MUTCD.

END OF SECTION

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## **SECTION 01 57 00 TEMPORARY CONTROLS**

This specification changes a portion of APWA Standard Specification Section 01 57 00. All other provisions of the Section remain in full force and effect.

Change the following paragraph in **Article 3.2 DUST AND MUD CONTROL** to:

- C. At a minimum, dust and mud control efforts shall include a daily sweeping of the work area streets. One sweeping shall take place at the end of the workday at a minimum, if needed additional sweeping shall take place midway through the workday. Additional efforts may be required as determined by the ENGINEER, OWNER, SWPPP inspector, or other representative.

Add the following paragraph in **Article 3.2 DUST AND MUD CONTROL**:

- D. Contractor shall prepare, submit and implement a Fugitive Dust Control Plan with the Utah Department of Environmental Quality, Division of Air Quality.

Change the following paragraph to **Article 3.3 SURFACE WATER CONTROL** to:

- A. Control all on-site surface water. Provide proper drainage so flooding of the site or changed flow conditions including path, quantity or quality onto an adjacent property does not occur.

Add the following paragraph to **Article 3.3 SURFACE WATER CONTROL**:

- E. CONTRACTOR shall prepare a Storm Water Pollution Prevention Plan (SWPPP) specifically for this project in compliance with Salt Lake City and State of Utah requirements for Stormwater Discharges Associated with Construction and Land Disturbance Activities. CONTRACTOR shall comply with all Clean Water Act, City Ordinance and SWPPP requirements for the project.
- F. Some minimum erosion control and storm water protection components have been identified. These do not constitute all necessary components of a comprehensive SWPPP.
  - 1. For projects less than one acre the CONTRACTOR shall provide all labor, equipment, materials, and services necessary to complete the work.
    - a) Site Map: Showing boundaries and BMPs that will be implemented.
    - b) Concrete washout: Describe in detail how concrete washout will be contained.
    - c) Concrete/Road cutting (must be contained): Describe in detail how concrete & road cutting dust and pollutants will be contained.
    - d) Housekeeping BMPs: Describe in detail general housekeeping e.g. restroom (port-a-potty), dumpster(s), roll off container or cans, etc.
    - e) Erosion/sediment controls: Describe in detail the boundary controls to be used e.g. inlet protection, silt fence, fiber rolls, wattle, cut back, etc.
    - f) Offsite tracking prevention: Describe in detail how you will mitigate tracking dirt/mud outside of construction boundaries in compliance with the City's Clean Wheel Ordinance.
    - g) De-watering: Describe in detail BMPs that will be used to de-silt the discharge before entering a waterway/storm drain e.g. de-watering bag, filter sock, check down dam, frac tank, etc.
  - 2. The CONTRACTOR shall identify type and placement of BMPs.
  - 3. The CONTRACTOR shall be responsible for implementation and maintenance of all BMPs.
  - 4. The CONTRACTOR shall perform weekly inspections of the site for the duration of

the project. Note: Inspection shall include housekeeping, placement and condition of all BMPs.

5. The CONTRATOR shall be responsible stabilizing and removing all temporary BMPs at the conclusion of the job.
6. If work is being performed outside the boundaries of Salt Lake City the CONTRACTOR shall contact the MS4 operator and comply to any additional stormwater pollution prevention requirements for that jurisdiction.

G. If CONTRACTOR is assessed fines for not meeting permit requirements, those costs will not be passed onto the OWNER.

Change the following paragraph to **Article 3.4 GROUND WATER CONTROL** to:

- C. Remove all dewatering facilities meeting inspector requirements when no longer required.

Add the following **Article 3.7 Sanitation to Part 3 – Execution**

#### 3.7 Sanitation

- A. Toilet Facilities: Provide portable chemical toilets at each active work site or staging area for the use of employees. Toilets at construction job sites shall conform to the requirements of Part 1926 of the OSHA Standards for Construction.
  1. Furnish at least one portable toilet at each active work site.

END OF SECTION

## **SECTION 01 58 00 PROJECT IDENTIFICATION AND SIGNS**

### **PART 1 GENERAL**

#### **1.1 SECTION INCLUDED**

- A. Temporary on-site identification and informational signs to identify key elements of construction facilities and traffic routing.

#### **1.2 SUBMITTALS**

- A. Sketch of informational signs.

#### **1.3 QUALITY ASSURANCE**

- A. Sign Painter: Professional experienced in type of work required.
- B. Finishes, Painting: Adequate to resist weathering and fading for scheduled construction period.

### **PART 2 PRODUCTS**

#### **2.1 SIGN MATERIALS**

- A. Structure and Framing: May be new or used, wood or metal, in sound condition, structurally adequate to work and suitable for specified finish.
- B. Sign Surfaces: Exterior grade plywood
  - 1. Type 4'x4': 4-feet high by 4-feet wide
  - 2. Type 4'x8': 4-feet high by 8-feet wide
  - 3. Thickness: As required by standards to span framing members, resist wind loading, and to provide an even, smooth surface without waves or buckles.
- C. Rough Hardware: Galvanized steel or equal.
- D. Paint: Exterior quality
  - 1. Background: White
  - 2. Lettering: Black
  - 3. Accents: Green

### **PART 3 EXECUTION**

#### **3.1 PROJECT IDENTIFICATION SIGNS**

- A. Content to include:
  - 1. Title of Project
  - 2. City logo and motto
  - 3. Name of Mayor
  - 4. Names of City Council members and the district they represent
  - 5. Names of professional consultants and their titles
  - 6. Name of ENGINEER and title
  - 7. Name of CONTRACTOR
- B. Graphic design, style of lettering, colors: See Drawing
- C. Paint exposed surfaces of supports, framing, and surface material; one coat of primer and one coat of exterior paint.

- D. Erect on the site at a lighted location of high public visibility, adjacent to the main entrance to the site, as approved by ENGINEER.

### **3.2 INFORMATIONAL SIGNS**

- A. Size of signs and lettering: As required by regulatory agencies, or as appropriate to usage.
- B. Colors: As required by regulatory agencies, otherwise of uniform colors throughout project.
- C. Paint exposed surfaces: One coat of primer, and one coat of exterior paint.
- D. Paint graphics in styles, sizes, and colors selected.
- E. Install at a height for optimum visibility, on ground-mounted poles, or attached to temporary structural surfaces.

### **3.3 MAINTENANCE**



- A. Maintain signs and supports in a neat, clean condition; repair damages to structure, framing, or sign.
- B. Relocate information signs, as required by progress of the Work.
- C. Remove graffiti from signs immediately.

### **3.4 REMOVAL**

- A. Remove signs, framing, supports, and foundations at completion of Project.
- B. Repair landscaping, and surface improvements damaged by removal.



# PROJECT IDENTIFICATION SIGN USE WITHIN SALT LAKE CITY LIMITS

<b>Salt Lake City Corporation – Department of Public Utilities</b>		
		
<b>MP3.16 – NORTH BENCH PUMP STATION PROJECT</b>		
<b>Hilltop Road – Project No. 513416337</b>		
<b>BUILDING A BETTER CITY</b>		
<b>ERIN MENDENHALL, MAYOR</b>		
<b>CITY COUNCIL</b>		
<u>District 1</u> VICTORIA PETRO	<u>District 2</u> ALEJANDRO PUY	<u>District 3</u> CHRIS WHARTON
<u>District 4</u> EVA LOPEZ CHAVEZ	<u>District 5</u> DARIN MANO	<u>District 6</u> DAN DUGAN
<u>District 7</u> SARAH YOUNG		
<b>LAURA BRIEFER, DIRECTOR</b>		
		
CONSTRUCTION COMPANY NAME COMPANY ADDRESS COMPANY PHONE NUMBER	<b>CONTACT: INSPECTOR NAME</b> <b>SALT LAKE CITY INSPECTOR</b> <b>PHONE NO: 801-###-####</b>	SALT LAKE CITY CORPORATION GARY KOBZEFF, PROJECT MANAGER PHONE NO: 801-483-####
PUBLIC UTILITIES DISPATCH 801-483-6700		

SEAL – 8” RADIUS “BLACK”  
BACKGROUND WHITE

TEXT SIZE / COLOR  
2.5” – “BLACK”

TEXT SIZE / COLOR  
1.0” – “BLACK”

3/4” CDX PYLWOOD

TEXT SIZE / COLOR  
3/4” – “BLACK”

44” x 2” BAR  
“LIGHT GREEN”

TEXT SIZE / COLOR  
1/2” – “BLACK”

**4' x 4' PROJECT SIGN ATTACHED TO WOODEN OR METAL POSTS**

NOTE: SEE APWA SPECIFICATION 01 58 00 FOR DETAILED INFORMATION  
REGARDING PROJECT SIGNS.

END OF SECTION

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## **SECTION 01 67 00**

### **UTILITY MATERIALS**

#### **PART 1 GENERAL**

##### **1.1 SECTION INCLUDES**

A. Manufactured units and components for utility services.

##### **1.2 REFERENCES**

A. American Public Works Association (Utah Chapter).

1. APWA 01 25 00: Product Options and Substitutions.
2. APWA Publication: Manual of Standard Plans.

#### **PART 2 PRODUCTS**

##### **2.1 MANUFACTURED UNITS**

A. Provide products specified in the following tables. No substitutions permitted without ENGINEER's written approval (see paragraph 6.4 of Document 00 72 00 GENERAL CONDITIONS):

**Table 1 – WATER**

STD PLAN #	DESCRIPTION	PART NUMBER
All	Main line pipe material	<ul style="list-style-type: none"><li>• Ductile iron -- class 53 cement mortar lined</li><li>• Ductile iron – class 350 cement mortar lined</li><li>• PVC -- SDR 18 (C-900) diameters 8" to 18", C-905 and C-909</li></ul> Note: Other materials can be used only after approval by Chief Engineer.
All	Service line pipe material	Type K soft copper
502	27" Frame and cover -- smooth surface "waffle" pattern	D&L A-1005, Olympic MHU-1000
503	38" Frame and double cover -- smooth surface "waffle" pattern Notes: (1) Valves larger than 16" require larger ring and cover. Size will be specified by Chief Engineer. (2) Contractor to provide 1" diameter lifting hole and pry notch in larger lids.	D&L A-1426

511	Hydrant	Mueller Centurion (A-423), M & H 129 (SLC Specs) Clow 2500, Clow Medallion, Waterous WB-67
511	Two piece cast iron valve box (screw type)	Tyler 6850, D&L M-9042, Olympic VBU-8310
511	Two piece cast iron valve box (slip type)	D&L M-8042, Olympic VBU-8210, Tyler 6855
511	Gate valve	Resilient seat gate valve AWWA C509 NRS
511, 552, 574	Ductile iron traffic box	Spanish Fork Foundry SVB 090 D&L M-9009
521	Meter box cover	Ford X32 Tyler 6150 with 1-1/32" bronze bolt
521	Meter box (notched out)	Rigid PVC Corrugated Polyethylene AMCO 1830 WMB concrete
521	3/4" meter setter	Mueller B-2404 with tie bar – 21" riser Ford VB-73-21W-11-33
521	1" meter setter	Mueller B-2404 with tie bar – 21" riser Ford VB-74-21W -11-44
521	Meter insulation	Ford meter pit insulation blanket
523, 525, 529	Top section of valve box with lid	D&L M-80 series
551	Corporation stop	Mueller H-15000 Ford F600
551	Service saddle for DI pipe	Ford 202B
551	Service saddle for PVC and AC pipe	ROMAC 202N
552	Two piece cast iron valve box	Tyler 6870 D&L M-9145
552	Locking compression adapter Or	Mueller H-15428 Ford C84-66-G (1-1/2") Ford C84-77-G (2")

	Brass copper flared male adapter	Mueller H-15425 Ford C28-66 (1-1/2") Ford C28-77 (2")
552	Ball valve corp. stop	Ford B81-666 (1-1/2") Ford B81-777 (2")
552	Service Saddle (double strap)	Ford 202B Romac 202N
572	Gate valve (MJ x flange)	Gate valve AWWA C509 NRS
572	Detector check valve	Hersey Model DC

**Table 2 - SANITARY SEWER**

STD PLAN #	DESCRIPTION	PART NUMBER
All	Pipe Materials	Reinforced Concrete -- class III (18" through 96") Non-reinforced Concrete -- class 3 (8" through 15") PVC -- SDR 35 (4" through 27") Notes: (1) Other materials can be used only after approval by Chief Engineer. (2) Special concrete mix may require a poly lining for additional protection for concrete pipe from hydrogen sulfide (H <sub>2</sub> S) gas may be required. (3) Rubber O-ring gaskets as per ASTM C-433.
402	30" Frame and cover -- smooth surface "waffle" pattern	D&L Supply A-1180, Olympic MHU-1060
402	Special Lid	D&L Supply A-1181, Olympic MHU-1070 Note: Required if surface water can enter manhole.
411	5' diameter pre-cast concrete manhole bases	Prior approval by Chief Engineer required.
411	Manhole section joint sealant	Ramneck Note: Concrete grouting of manhole section joints is additionally required.
411	Manhole gaskets	Elastomeric rubber (ASTM C 443)

411	Manhole adapter/water stop gasket	Romac LCT
431	Pipe coupling	Fernco neoprene couplings, adapter, bushings
431	Inline integral wye fittings	Factory fabricated
431	Lateral connections Note: For connections to 18" and larger sewer mains only.	Inserta Tee

**Table 3 - STORM DRAIN**

STD PLAN #	DESCRIPTION	PART NUMBER
All	Pipe materials	Reinforced Concrete -- class III HDPE-N12 pipe Note: Other materials can be used only after approval by Chief Engineer.
302	30" Frame and cover -- smooth surface "waffle" pattern	D&L Supply A-1180 (vented) D&L Supply A-1181 (solid) Olympic MHU-1060 & MHU-1070
303	44" Frame and cover -- smooth surface "waffle" pattern	D&L Supply A-1460,
304	48" Cover and frame -- smooth surface "waffle" pattern	D&L Supply H-1801,
305	51" Cover and frame -- smooth surface "waffle" pattern	D&L Supply H-1810
308	Grate and frame with adjustable curb box	D&L Supply I-3518
309	47-3/4" Grate and frame	D&L Supply I-1803
321	Automatic flap gate	

## **PART 3 EXECUTION**

### **3.1 METERS**

- A. 3/4-inch and 1-inch meters are provided and installed by Salt Lake City Public Utilities Department.
- B. For meter installations greater than 1-inch, Salt Lake City Public Utilities Department will provide the meter and bypass assembly for installation by the CONTRACTOR.

END OF SECTION

## **SECTION 01 71 13**

### **MOBILIZATION AND DEMOBILIZATION**

This specification changes a portion of APWA Standard Specification Section 01 71 13. All other provisions of the Section remain in full force and effect.

Add the following paragraph:

#### **1.5 SUBMITTALS**

- A. Project Video Recording: Video record the project area prior to commencing construction. The ENGINEER's representative shall be present during recording. The recording shall be performed on foot, noting all salient existing features in the project area and the location of the recording shall be clearly indicated. "Drive-by" video recording will not be accepted. The video recording shall be submitted to the ENGINEER a minimum of 5 days prior to starting construction.

END OF SECTION

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# **PART 5**

## **TECHNICAL SPECIFICATIONS**

### **(BY ENGINEER)**

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**SECTION 01 14 00  
WORK RESTRICTIONS**

**PART 1 GENERAL**

- A. OWNER and/or utility owners may be working within the Project area while this Contract is in progress. If so, CONTRACTOR shall schedule Work in conjunction with these other entities to minimize mutual interference.
- B. All compaction and other testing requirements specified shall be provided and paid for by CONTRACTOR.
- C. CONTRACTOR shall notify ENGINEER of the schedule for materials testing as required in Section 01 45 00 Quality Control and Materials Testing and Section 01 45 23 Testing Agency Services a minimum of 24 hours in advance in order to provide ENGINEER time to be present during desired testing. CONTRACTOR shall be responsible for obtaining copies of testing reports or data and ensuring that the Work is in full compliance with the Contract Documents.
- D. CONTRACTOR shall notify owners of Private rights-of-way 72 hours prior to work being performed across owner's right-of-way.
- E. If required to work in City Streets, CONTRACTOR shall notify right-of-way owner 72 hours prior to work being performed therein. Work within the City Streets shall be in accordance with required permits and any license agreement with OWNER. CONTRACTOR shall obtain and comply with all required permits.
- F. CONTRACTOR must work with all adjacent property owners to ensure no harm or damage is caused to homes or other structures or property during construction of the project.
- G. CONTRACTOR shall ensure existing drinking water pipelines, and pump station remain operational except as allowed by shutdowns noted below. CONTRACTOR may sequence construction as follows. If CONTRACTOR sequencing deviates from this proposed method, it must be submitted and reviewed with ENGINEER:
  - 1. PHASE 1:
    - Construct all 18-inch drinking water pipelines which do not require a shutdown.
    - Install all 18-inch pipes, fittings, and appurtenances shown in the Contract Drawings parallel to the existing CCWTP supply (down to existing North Bench pump station), tank inlet tee (excluding vault), and Morris outlet vault.
  - 2. PHASE 2:
    - Temporary shutdown of Morris Reservoir (drained), CCWTP (between tie-in points), and a closure of Hilltop Road. These facilities may only be shutdown between October 15 to April 15. Multiple shutdowns are allowed, given time between shutdowns to completely refill the Morris Reservoir. Once a shutdown has commenced, work during that shutdown must be completed within 4 days.

- Complete construction of remaining 18-inch drinking water pipeline, including:
    - Make tie-in connections of the new CCWTP 18-inch pipeline at north and south extent to existing pipeline.
    - Replace 18-inch CCWTP pipeline in Hilltop Road.
    - Connect to existing check valve vault.
    - Install improvements to 10-inch PRV bypass.
    - Connect to Morris Reservoir inlet. Complete construction of inlet vault.
    - Delay installing V-36 (see Contract Drawing Sheet C-20) in the inlet vault. Install spool and throttle inflow to the tank by manually adjusting V-35.
    - Connect Morris Reservoir outlet pipe to new outlet vault.
    - Test and commission new 18-inch CCWTP supply pipeline, Morris Reservoir inlet and outlet piping and 10-inch PRV bypass.
  - End shutdown of Morris Reservoir, CCWTP Pipeline, and Hilltop Road.
3. PHASE 3:
- This phase may be started or finished independently of phases 1 and 2.***
- Construct the new North Bench pump station and piping, including:
    - Install all 20-inch and 12-inch drinking water pipelines.
    - Install all 10-inch discharge pipes which do not require a shutdown.
    - All other remaining improvements required for an operational drinking water system which do not require a shutdown.
    - Once the new North Bench pump station has been tested and commissioned, a temporary waterline shutdown will be required to switch over service to the new pump station.
    - Connections to the existing 10-inch drinking water pipelines within the North Bench Low and Arlington Hills Pressure Zones will be made.
    - Construct a temporary bypass from the new North Bench Low discharge pipeline to the existing North Bench Low discharge. This is to bypass the existing pump station and facilitate seamless transitions to the new pump station. Review bypass plan with ENGINEER a minimum of 1 week prior to constructing bypass.
  - This switchover and associated shutdown may only take place from Oct 15 to April 15 and must be completed within 10 days of commencement.
  - Phase 4 may not be started until all previous phases are completed.
4. PHASE 4:
- Second shutdown of Hilltop Road.
  - Install the remaining 10-inch pipeline serving North Bench Low pressure zone down Hilltop Road and connect to the existing system.
  - After successful testing and disinfection, abandon all existing and/or temporary connections to or bypasses for the existing pump station.
5. PHASE 5:
- Decommission, demolish and remodel existing North Bench pump station in accordance with Contract Drawings.
6. Other construction activities performed independently of Phase 1-5:
- Ensign Downs vault construction and improvements.
  - Ensign Downs Low Tank valve replacement.
  - Slip-line sewer lateral to existing pump station.

- H. Work sequence and constraints presented do not include all items affecting completion of the Work, but are intended to describe critical events necessary to minimize disruption of the existing facilities and to ensure compliance with Utah Pollutant Discharge Elimination System (UPDES) and other permit requirements.

**PART 2 PRODUCTS (Not Used)**

**PART 3 EXECUTION (Not Used)**

- END OF SECTION -

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**SECTION 01 30 00**  
**ADMINISTRATIVE REQUIREMENTS**

**PART 1 GENERAL**

**1.1 COORDINATION AND PROJECT CONDITIONS**

- A. Coordinate scheduling, Submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.
- B. Coordinate completion and clean-up of Work of separate sections in preparation for Substantial Completion.
- C. After OWNER occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of OWNER's activities.
- D. UDOT, OWNER, Salt Lake City and/or utility owners may be working within the project area while this contract is in progress. If so, CONTRACTOR shall schedule Work in conjunction with these other organizations to minimize mutual interference.
- E. All existing Salt Lake City waterlines and service connections shall remain active during the construction of this project. All connections to the existing waterlines, except those being hot-tapped, shall only be done upon successful completion of mainline installation and testing.
- F. Water service to this area can be interrupted for a maximum of 4 hours. CONTRACTOR shall provide a minimum notice of 24 hours to each home or business affected. A copy of CONTRACTOR'S notification letter shall be reviewed and approved by OWNER prior to distribution.
- G. If required to work in City Streets or Utah Department of Transportation (UDOT) right-of-way, CONTRACTOR shall notify UDOT 72 hours prior to work being performed therein. Work within the City Streets or UDOT right-of-way shall be in accordance with their required permit and their license agreement with OWNER. CONTRACTOR shall obtain and comply with all required permits.
- H. Coordination with Adjacent Property Owner
  - 1. Once each week, CONTRACTOR shall hand deliver or mail a written "**Construction Status Update Notice**" to all residents, businesses, schools and property owners adjacent to and affected by the Work. Notice shall be on CONTRACTOR's company letterhead paper and be secured to doorknob should occupants not be home. Obtain ENGINEER's review of notice prior to distribution. As a minimum the notice shall contain the following:
    - a. name and phone number of CONTRACTOR's representative for the project
    - b. work anticipated for the next 7 days including work locations and work by subcontractors and utility companies
    - c. rough estimate of construction schedule through end of project

- d. anticipated driveway approach closures
  - e. anticipated water, sewer or power outages
  - f. anticipated vehicular traffic impacts, rerouting or lane closures
  - g. anticipated pedestrian impacts and sidewalk closures
  - h. changes to public transportation bus routes
  - i. any other construction or work items which will impact or restrict the normal use of streets and amenities
2. Failure to comply with this contract provision is considered grounds for project suspension per Article 15.1 of the General Conditions.

## **1.2 FIELD ENGINEERING**

- A. ENGINEER shall provide the following construction staking at no cost to CONTRACTOR.
- 1. Benchmark network throughout the construction zone
- B. Construction staking and surveying shall be performed by a registered Land Surveyor in the State of Utah.
- C. CONTRACTOR shall provide all other survey construction staking as necessary to complete the required work according to the Contract Documents.
- D. ENGINEER shall not be responsible for stakes, etc. removed through negligence of CONTRACTOR and in that event shall be compensated by CONTRACTOR for re-staking efforts.
- E. CONTRACTOR shall locate and protect survey control and reference points. Promptly notify ENGINEER of discrepancies discovered.
- F. Control datum for survey is that shown on Contract Drawings.
- G. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- H. Promptly report to ENGINEER loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- I. CONTRACTOR shall be responsible to coordinate with all property owners to determine the location of existing sewer and water service laterals. CONTRACTOR shall be responsible to coordinate with all property owners during installation or relocation of existing service laterals.
- J. All service laterals shall be verified and indicated on the Record Drawings supplied by CONTRACTOR to ENGINEER.

## **1.3 PRECONSTRUCTION MEETING**

- A. Prior to the commencement of work at the site, a preconstruction conference will be held at a mutually agreed time and place which shall be attended by CONTRACTOR's



Project Manager, its superintendent, and its subcontractors as appropriate. Other attendees will be:

1. ENGINEER and the Resident Project Representative (RPR)
  2. Representatives of OWNER
  3. Governmental representatives as appropriate
  4. Others as requested by CONTRACTOR, OWNER, or ENGINEER.
- B. Unless previously submitted to ENGINEER, CONTRACTOR shall bring to the conference one copy of each of the following:
1. Progress schedule
  2. Procurement schedule of major equipment and materials and items requiring long lead time
  3. Shop Drawings/Sample/Substitute or "Or Equal" submittal schedule.
- C. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The agenda may include the following:
1. CONTRACTOR's tentative schedules
  2. Transmittal, review, and distribution of CONTRACTOR's submittals
  3. Processing applications for payment
  4. Maintaining record documents
  5. Critical work sequencing
  6. Field decisions and Change Orders
  7. Use of project site, office and storage areas, security, housekeeping, and OWNER's needs
  8. Major equipment deliveries and priorities
  9. CONTRACTOR's assignments for safety and first aid
- D. OWNER will preside at the preconstruction conference and will arrange for keeping the minutes and distributing the minutes to all persons in attendance.
- E. CONTRACTOR should plan on the conference taking no less than 1 working day.

#### **1.4 PROGRESS MEETINGS**

- A. CONTRACTOR shall schedule and hold regular on-site progress meetings at least weekly and at other times as required by ENGINEER or as required by progress of the work. CONTRACTOR, ENGINEER, and all subcontractors active on the site shall be represented at each meeting. CONTRACTOR may at its discretion request attendance by representatives of its suppliers, manufacturers', and other subcontractors.
- B. ENGINEER shall preside at the meetings and provide for keeping and distribution of the minutes. The purpose of the meetings will be to review the progress of the work, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop.
- C. At each construction progress meeting a progress report shall be presented by CONTRACTOR containing an updated Progress Schedule. Where the delayed

completion date of a project phase is noted, CONTRACTOR shall describe the anticipated delays or problems and outline the action plan being taken to resolve the issues.

**PART 2 PRODUCTS (Not Used)**

**PART 3 EXECUTION (Not Used)**

- END OF SECTION -

**SECTION 01 33 01**  
**ADDITIONAL SUBMITTAL PROCEDURES**

**PART 1 GENERAL**

**1.1 GENERAL**

- A. See Section 01 33 00 for Submittal procedure requirements. This Section provides additional clarification that CONTRACTOR must follow for preparing and providing Submittals to ENGINEER for review. If there are discrepancies between this Section and Section 01 33 00 the more stringent requirement shall take precedence.
- B. CONTRACTOR shall anticipate resubmitting Submittals for major equipment or complex systems.
- C. If CONTRACTOR has questions about submittal requirements, CONTRACTOR is encouraged to communicate with ENGINEER to discuss requirements prior to submitting the Submittal.
- D. Substitutions shall be clearly identified on the Submittal transmittal form and shall include all the information required per Section 01 60 00 – Product Requirements.

**1.2 DEFINITIONS**

- A. Shop Drawings: Drawings, diagrams, schedules, and other data specially prepared for the Work by CONTRACTOR to illustrate some portion of the Work.
- B. Product Data: Illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by CONTRACTOR to illustrate materials or equipment for some portion of the Work. Product data is typically collected from catalogs, technical data sheets, or other materials supplied by manufacturers and are not specifically prepared for the project. Product data shall be marked up and/or highlighted to show the model, style, or options of a product to be incorporated in the Work.
- C. Samples: Physical examples that illustrate materials, equipment, workmanship, or colors, and establish standards by which the Work will be judged.
- D. Submittal Dispositions shall be defined as follows:
  - 1. No Exception Taken: ENGINEER and/or OWNER has reviewed the Submittal with skill, care, and judgement consistent with the applicable standard of care and, in accordance with the General Conditions, has determined the submittal appears to be consistent with the contract documents and the design professional's design intent for the completed project.
  - 2. Make Corrections Noted: ENGINEER and/or OWNER has reviewed the Submittal and approval is conditioned on CONTRACTOR, subcontractor, or supplier complying fully with ENGINEER's written comments on the Submittal. Failure of the CONTRACTOR, subcontractor, or supplier to comply fully with the written comments nullifies the approval.

3. Revise and Resubmit: ENGINEER and/or OWNER has reviewed the Submittal and believes the Submittal, as furnished, cannot be approved without revisions and resubmittal. "Revise and Resubmit" does not constitute an approval.
4. Rejected: ENGINEER and/or OWNER has reviewed the Submittal and determined that it cannot be approved because it is incomplete, does not meet the product requirements or specifications, or does not meet the Submittal Procedure requirements as noted below.
5. For Information Only: Submittal is for record only and was not reviewed by ENGINEER and/or OWNER.

### **1.3 SUBMITTAL PROCEDURES**

- A. See Section 01 33 00 Submittal Procedures.
- B. Each Submittal shall contain material pertaining to no more than one equipment or material item.
- C. Each Submittal shall have the Specification section and applicable paragraph number clearly identified on the front of the Submittal transmittal form. A copy of the Specification section and applicable paragraph shall be included with the Submittal and items included shall be clearly marked as either in compliance or not in compliance. For items not in compliance a description shall be provided explaining the reason for non-compliance.
- D. CONTRACTOR shall review Submittals prior to submission to ENGINEER. Apply Contractor's stamp, signed and dated, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents. Identify any deviations from the Contract Documents on the Submittal transmittal form.
- E. Submittals shall be submitted sufficiently in advance to allow ENGINEER not less than ten regular working days for examining the drawings. These drawings shall be accurate, distinct, and complete and shall contain all required information, including satisfactory identification of items and unit assemblies in relation to the Contract Drawings and/or specifications.
- F. Identify variations from Contract Documents and product or system limitations which may adversely affect successful performance of completed Work.
- G. If a Submittal is returned to CONTRACTOR marked "NO EXCEPTIONS TAKEN", or similar notification, formal revision and resubmission will not be required.
- H. If a Submittal is returned marked "MAKE CORRECTIONS NOTED", or similar notification, CONTRACTOR shall make the corrections on the Submittal, however, formal revision and resubmission will not be required.
- I. Resubmittals
  1. If a Submittal is returned marked "REVISE AND RESUBMIT", or similar notification, CONTRACTOR shall revise the Submittal and resubmit the required number of copies.
  2. Identify changes made since the previous submission.

#### J. Rejected Submittals

1. If a Submittal is returned marked "REJECTED", or similar notification, it shall mean either that the proposed material or product does not satisfy the specification, the Submittal is so incomplete that it cannot be reviewed or is a substitution request not submitted in accordance with Section 01 60 00 – Product Requirements.
  2. CONTRACTOR shall prepare a new Submittal or submit a substitution request according to Section 01 60 00 – Product Requirements and shall submit the required number of copies.
- K. Unless noted otherwise, corrections indicated on Submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the Contract requirements.
- L. Fabrication or purchase of an item may only commence after ENGINEER has reviewed the pertinent Submittals and returned copies to CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED".
- M. ENGINEER's review of CONTRACTOR Submittals shall not relieve CONTRACTOR of the entire responsibility for the corrections of details and dimensions. CONTRACTOR shall assume all responsibility and risk for any misfits due to any errors in CONTRACTOR Submittals. CONTRACTOR shall be responsible for dimensions and quantities, coordinating with all trades, the design of adequate connections and details, and satisfactory and safe performance of the work.

#### 1.4 NSF CERTIFICATION

- A. Where NSF/ANSI 61 and/or NSF/ANSI 600 approval is required, submit ANSI/NSF 61/600 certification letter from the testing agency, i.e., NSF International (NSF), ALS - Truesdail Laboratories, UL Solutions, Water Quality Association (WQA), etc., for each item indicating the product fabrication location and application limits such as plant location, size of tank or diameter of piping, or other limitations.
- B. See example NSF certificate below in Exhibit A.

#### 1.5 OPERATIONS AND MAINTENANCE MANUAL SUBMITTAL

- A. CONTRACTOR shall furnish to ENGINEER two (s) identical sets of Operations and Maintenance Manuals. Each set shall consist of one or more volumes, each of which shall be bound in a standard size, 3-ring, loose-leaf, vinyl, hard-cover binder suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches. A Table of Contents shall be provided which indicates all equipment and suppliers in the Operations and Maintenance Manuals.
- B. CONTRACTOR shall also furnish ENGINEER one copy of the Operations and Maintenance Manuals in PDF electronic format.
- C. CONTRACTOR shall include in the Operations and Maintenance manuals full details for care and maintenance for all visible surfaces as well as the following for each item of mechanical, electrical, and instrumentation equipment (except for equipment furnished by OWNER):



1. Complete operating instructions, including location of controls, special tools or other equipment required, related instrumentation, and other equipment needed for operation.
  2. Preventative maintenance procedures and schedules
  3. A description of proper maintenance activities
  4. Complete parts lists, by generic title, identification number, and catalog number, complete with exploded views of each assembly.
  5. Disassembly and reassembly instruction
  6. Name and location of nearest supplier and spare parts warehouse
  7. Name and location of manufacturer
  8. Recommended troubleshooting and start-up procedures
  9. Prints of the record drawings, including diagrams and schematics, as required under the electrical and instrumentation portions of these specifications.
- D. All Operations and Maintenance manuals shall be submitted in final form to ENGINEER not later than the 75 percent of construction completion date. All discrepancies found by ENGINEER in the Operations and Maintenance manuals shall be corrected by CONTRACTOR prior to final acceptance of the project.

**PART 2 PRODUCTS (Not Used)**

**PART 3 EXECUTION (Not Used)**

- END OF SECTION -

## Exhibit A - Example NSF 61 Certification



**ALS Group USA, Corp.**  
3337 Michelson Drive, Suite CN750, Irvine, CA 92612

**Certified Product Listing**

**For:**  
Drinking Water System Components – Health Effects

**Company:**  
Mueller Industries, Inc.  
150 Schilling Blvd  
Suite 100  
Collierville, TN 38017, United States

**Plant Location:**  
Fulton, MS, United States

**Standards:**  
NSF/ANSI/CAN 61 - 2022  
NSF/ANSI/CAN 372 - 2022



**Certificate:**  
Issued Date: 01/22/2019

**Material/Product:**  
Pipe and Related Products - Tubing/Hose

**Contact Temperature:**  
82 ± 2°C

**Models:**  
Streamline >= 1/2"

**Other Limitations:**  
Copper tube (Alloy C12200) is Certified to NSF/ANSI 61-2017 for use in drinking water suppliers of pH 6.5 and above. Drinking water supplies that are less than pH 6.5 may require corrosion control to limit leaching of copper into the drinking water.



Product certified to NSF/ANSI/CAN 372 conforms to the requirements for "Lead Free" plumbing products as defined by California, Vermont, Maryland and Louisiana state laws and by section 1417 of the US SDWA.

ALS Group's Product Certification Listing directory contains the most current certified product(s) and supersedes all printed copies of the listings.

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**SECTION 01 42 13**  
**ABBREVIATIONS**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of these Specifications, the following acronyms or abbreviations which may appear in these Specifications shall have the meanings indicated herein.

**1.2 ABBREVIATIONS AND ACRONYMS**

AASHTO	American Association of the State Highway and Transportation Officials
ABMA	American Bearing Manufacturers Association (formerly AFBMA)
ACI	American Concrete Institute
AGA	American Gas Association
AGC	American General Contractors
AI	The Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ANSI	American National Standards Institute, Inc.
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASOC	American Society of Quality Control
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
AWPB	American Wood Preservers Bureau
BBC	Basic Building Code, Building Officials and Code Administrators International
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CMA	Concrete Masonry Association
CRSI	Concrete Reinforcing Steel Institute
DIPRA	Ductile Iron Pipe Research Association
DWQ	Department of Water Quality
DWR	Drinking Water Regulations
ECTC	Erosion Control Technology Council
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
ETC	Electrical Test Laboratories

FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FM	Factory Mutual System
HI	Hydraulic Institute
IBC	International Building Code
ICBO	International Conference of Building Officials
ICC	International Code Council
ICC-ES	International Code Council Evaluation Service
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFC	International Fire Code
IMC	International Mechanical Code
IME	Institute of Makers of Explosives
IPC	International Plumbing Code
ISA	Instrument Society of America
ISO	International Organization of Standardization
ITE	Institute of Traffic Engineers
LPI	Lightning Protection Institute
LRQA	Lloyd's Register Quality Assurance
MBMA	Metal Building Manufacturer's Association
MSS	Manufacturers Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBS	National Bureau of Standards
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NISO	National Information Standards Organization
NSF	NSF International (formerly National Sanitation Foundation)
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
RCRA	Resource Conservation and Recovery Act
RMA	Rubber Manufacturers Association
RWMA	Resistance Welder Manufacturer's Association
SAE	Society of Automotive Engineers
SSPC	Society for Protective Coating (formerly Steel Structure Painting Council)
SSPWC	Standard Specification for Public Works Construction
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
WCRSI	Western Concrete Reinforcing Steel Institute
WI	Woodwork Institute
WRI	Wire Reinforcements Institute, Inc.
WWPA	Western Wood Products Association

## **PART 2 PRODUCTS (Not Used)**

## **PART 3 EXECUTION (Not Used)**

- END OF SECTION -

**SECTION 01 42 19**  
**REFERENCE STANDARDS**

**PART 1 GENERAL**

**1.1 QUALITY ASSURANCE**

- A. TITLES OF SECTIONS AND PARAGRAPHS. Captions accompanying Specifications sections and paragraphs are for convenience of reference only, and do not form a part of the Specification.
- B. APPLICABLE PUBLICATIONS. Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is specified, only the latest specifications, standards or requirements of the respective issuing agencies which have been published as of the date that the work is advertised for bids, shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth herein or shown on the drawings shall be waived because of any provision of, or omission from, said standards or requirements.
- C. SPECIALISTS, ASSIGNMENTS. In certain instances, specifications test requires (or implies) that specific work is to be assigned to specialists or expert entities, who must be engaged for the performance of that work. Such assignments shall be recognized as special requirements and shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the work; also they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of work is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of contract requirements remains with CONTRACTOR.

**1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS**

- A. Without limiting the generality of other requirements of the Specifications, all Work specified herein shall conform to or exceed the requirements of all applicable codes and the applicable requirements of the following documents to the extent that the provisions of such documents are not in conflict with the requirements of these Specifications nor the applicable codes.
- B. Reference herein to "Building Code" or "Uniform Building Code" shall mean the International Building Code of the International Code Council. The latest edition of the code as approved and used by the local agency as of the date of award, as adopted by the agency having jurisdiction, shall apply to the Work herein, including all addenda, modifications, amendments, or other lawful changes thereto.
- C. In case of conflict between codes, reference standards, drawings and the other Contract Document, the most stringent requirements shall govern. All conflicts shall be brought to the attention of ENGINEER for clarification and directions prior to ordering or providing any materials or labor. CONTRACTOR shall bid the most stringent requirements.
- D. APPLICABLE STANDARD SPECIFICATIONS. CONTRACTOR shall construct the Work specified herein in accordance with the requirements of the Contract Documents

and the referenced portions of those referenced codes, standards, and Specifications listed herein; except, that wherever references to "Standard Specifications" are made, the provisions therein for measurement and payment shall not apply.

- E. References in the Contract Documents to "Standard Specifications" shall mean the Contract Documents including all current supplements, addenda, and revisions thereof.
- F. References herein to "OSHA Regulations for Construction" shall mean Title 29, Part 1926, Construction Safety and Health Regulations, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- G. References herein to "OSHA Standards" shall mean Title 29, Part 1910, Occupational Safety and Health Standards, Code of Federal Regulations (OSHA), including changes and amendments thereto.
- H. UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY. Wells, tanks, pumping stations and culinary water pipelines shall conform to the requirements of Utah Administrative Code Rule R 309. Water and sewer pipeline installation shall conform to the requirements of Utah Administrative Code Rule R 317-3-2.9 "Protection of Water Supplies" for horizontal and vertical separation.
- I. UTAH DEPARTMENT OF TRANSPORTATION (UDOT) REQUIREMENTS. CONTRACTOR's work on UDOT property or right-of-way shall conform to UDOT's latest edition of Standard Specifications For Road and Bridge Construction.
- J. U.S. ARMY CORPS OF ENGINEERS (COE) REQUIREMENTS. CONTRACTOR's work shall conform to COE Specifications in accordance with Section 404 of the Clean Water Act for excavation in wetlands.
- K. Reference herein to APWA shall mean the latest edition of the "Manual of Standard Specifications" and "Manual of Standard Plans" as prepared by the American Public Works Association and the Associated General Contractors of America.
- L. All provisions of the Manual of Standard Specifications, Latest Edition and Manual of Standard Plans, Latest Edition both published by the Utah Chapter of the American Public Works Association are hereby made a part of the Contract Documents by reference. The publications may be purchased separately from the Utah Technology Transfer Center, Utah State University, 4111 Old Main Hill, Logan, UT 84322-4111. Any conflicts, between the technical specifications, drawings, and other provisions or documents contained in the Contract Form or Contract Documents versus provisions contained in the Manual of Standard Specifications, Latest Edition and Manual of Standard Plans, Latest Edition published by the Utah Chapter of the American Public Works Association, shall be resolved in favor of the technical specifications, drawing, and provisions contained in the Contract form or Contract Documents.

## **PART 2 PRODUCTS (Not Used)**

## **PART 3 EXECUTION (Not Used)**

- END OF SECTION -

**SECTION 01 45 01**  
**QUALITY CONTROL AND MATERIALS TESTING (SUPPLEMENT)**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section 01 45 01 outlines responsibilities for controlling the quality of materials, products, and workmanship.

**1.2 TESTING ACCEPTANCE AND FREQUENCY**

- A. Minimum Quality Control Testing Frequency: As defined in Table 01 45 01-1, CONTRACTOR shall be responsible to ensure that all testing is performed at the frequencies shown. CONTRACTOR shall uncover any work at no cost to OWNER to allow the testing agency to perform required testing at the frequency shown.
- B. The testing agency and testing for quality control and material testing for Site Work including, but not limited to, buried piping backfill, concrete flatwork, road grading and paving, and structure backfill shall be provided and paid for by CONTRACTOR as part of the project. Results of testing shall be reported to CONTRACTOR and ENGINEER on site. Reports of the testing shall be transmitted directly to ENGINEER. The cost for CONTRACTOR testing shall be included in the associated lump sum bid for the item(s) being installed.
- C. OWNER shall provide and pay for Special Inspections and Testing for the structures including, but not limited to, soil foundation and structural fill, reinforcement, concrete, masonry, and wood framing.
- D. Acceptance of Defective Work: As defined in Article 13.8 of the General Conditions.

**PART 2 PRODUCTS (Not Used)**

**PART 3 EXECUTION**

**3.1 EXAMINATION**

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

**3.2 PREPARATION**

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

**TABLE 01 45 01-1: QUALITY CONTROL TESTING FREQUENCY**

<b>SYSTEM or MATERIAL</b>	<b>TESTS</b>	<b>MINIMUM REQUIRED FREQUENCY</b>
<b>SUBGRADE AND BACKFILL MATERIALS</b>		
Section 31 23 15 Excavation and Backfill for Buried Pipelines	Field Density	1 test per 200 linear feet per 1.5 feet of backfill thickness placed.
	Laboratory	1 test for each material type which includes proctor, classification, and gradation.
Section 31 22 00 Site Grading	Field Density	Embankment Fills – 1 test per lift for every 10,000 square feet of embankment
	Laboratory	1 test for each material type which includes proctor, classification, and gradation.
Section 31 23 23 Excavation and Backfill for Structures	Field Density	Footing and Wall Backfill – 1 test per every other lift for each 50 linear feet
		Under Structures – 1 test per lift for every 1,000 square feet of structure
		Around Structures – 1 test per lift for every 1,500 square feet of structure
		Unimproved Area – 1 test per lift for every 25,000 square feet of unimproved area
	Laboratory	1 test for each material type which includes proctor, classification, and gradation.
Section 32 11 23 Road Base - Untreated Base Course	Field Density	<u>Base course subgrade</u> : 1 test per 2,000 square feet of area. <u>Base course</u> : 1 test per 2,000 square feet of area.
	Laboratory	<u>Base course</u> : 1 test for each material type which includes proctor, classification, and gradation.
<b>ASPHALT</b>		
Section 32 12 16 Hot-Mix Asphalt Concrete Paving	Mix Design	<u>Marshall Test Method</u> : 1 test initially per each type of material and each change in target, and for each day of production thereafter. <u>Specific Gravity</u> : 1 per each Marshall Test <u>Extraction</u> : 1 test per each Marshall Test

SYSTEM or MATERIAL	TESTS	MINIMUM REQUIRED FREQUENCY
	Field Density	<u>Bituminous surfaces</u> : 1 test per 2,000 square feet placed or part thereof.
	Asphalt Thickness and Core Density	<u>Bituminous surfaces</u> : 1 test sample every 300 linear feet of completed roadway.
<b>PORTLAND CEMENT CONCRETE</b>		
Section 3 30 00  Cast-in-Place Concrete	Slump	1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs and more frequently if batching appears inconsistent.
	Entrained air	1 test with slump test.
	Ambient and concrete temperatures	1 test with slump test.
	Water cement ratio.	to be verified and provided with batch tickets.
	Compressive strength	1 set of 5 cylinders (See Note 5). 1 test every day of placement (if less than 100 cubic yards in a day), 1 test for every 100 cubic yards, or 1 test for each 3,000 square feet of surface area for slabs, and more frequently if batching appears inconsistent. (See Section 03 30 00-3.5.A.3 for additional requirements.) Each sample used to mold strength test specimens shall be tested for slump, air content, and temperature.
NOTES:		
1 Additional tests shall be conducted when variations occur due to CONTRACTOR's operations, weather conditions, site conditions, etc. 2 Classification, moisture content, Atterberg limits and specific gravity tests shall be conducted for each compaction test, if applicable. 3 Tests can substitute for same tests required under "Aggregates" (from bins or source), although gradations will be required when blending aggregates. 4 Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for water/cement calculations. 5 Strength tests shall be the average of the strengths of at least two (2) 6-inch diameter by 12-inch high cylinders. If 4-inch diameter cylinders are used, collect an additional cylinder (6 total) and the strength test shall be the average of the strengths of at least three (3) 4-inch by 8-inch high cylinders.		

- END OF SECTION -

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**SECTION 01 45 23**  
**TESTING AGENCY SERVICES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. CONTRACTOR shall be responsible for providing Construction Quality Control Testing of all soils, concrete, etc. as required by the various sections of these Specifications. This section includes the following:
1. Use of independent testing agency
  2. Control testing report submittal requirements
  3. Responsibilities of testing agency

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 3740      Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
  2. ASTM D 4561      Standard Practice for Quality Control Systems for Organizations Producing and Applying Bituminous Paving Materials
  3. ASTM E 329      Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

**1.4 DEFINITIONS**

- A. Independent Testing Agency: A testing agency NOT owned by CONTRACTOR, and an agency that does not have any preferential affiliation or association with CONTRACTOR, or any of CONTRACTOR's Subcontractors and Suppliers other than entering into a contract with CONTRACTOR to perform the duties defined in these Specifications.
- B. Professional Engineer: An engineer who complies with Utah licensing law and is acceptable to the authority having jurisdiction.

## **1.5 QUALITY ASSURANCE**

- A. CONTRACTOR shall employ and pay for services of an independent testing agency which complies with ASTM D 3740, ASTM D 4561, and ASTM E 329 to test materials for contract compliance.

## **1.6 CONTRACTOR SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures
- B. If CONTRACTOR is employing and paying for an independent testing agency, prior to start of Work, submit testing agency's name, address, telephone number and the following:
  - 1. Concrete Technician: Approved by ENGINEER or ACI certified.
  - 2. Person charged with engineering managerial responsibility
  - 3. Professional engineer on staff to review services
  - 4. Level of certification of technicians

## **1.7 TESTING AGENCY SUBMITTALS**

- A. Field Test Report: Submit report no later than the end of the current day.
- B. Laboratory Test Report: Submit original report within 48 hours after test results are determined.
- C. Final Summary Report: Submit prior to final payment
- D. On all reports include:
  - 1. Project title, number and date of the report
  - 2. Date, time and location of test
  - 3. Name and address of material Supplier
  - 4. Identification of product being tested and type of test performed
  - 5. Identify whether test is initial test or retest
  - 6. Results of testing and interpretation of results
  - 7. Name of technician who performed the testing

## **1.8 RESPONSIBILITIES OF TESTING AGENCY**

- A. Calibrate testing equipment at least annually with devices with an accuracy traceable to either National Bureau of Standards or acceptable values of natural physical constraints.
- B. Provide sufficient personnel at site and cooperate with CONTRACTOR, ENGINEER and OWNER's Representative in performance of testing service.
- C. Secure samples using procedures specified in the applicable testing code.
- D. Perform testing of products in accordance with applicable sections of the Contract Documents.
- E. Immediately report any compliance or noncompliance of materials and mixes to CONTRACTOR, ENGINEER, and OWNER's Representative.

- F. When an out-of-tolerance condition exists, perform additional inspections and testing until the specified tolerance is attained, and identify retesting on test reports.

#### **1.9 LIMITS ON TESTING AGENCY AUTHORITY**

- A. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
- B. Agency may not suspend Work.
- C. Agency has no authority to accept Work for OWNER.

#### **PART 2 PRODUCTS (Not Used)**

#### **PART 3 EXECUTION (Not Used)**

- END OF SECTION -

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**SECTION 01 50 00**  
**TEMPORARY CONSTRUCTION UTILITIES AND ENVIRONMENTAL CONTROLS**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This section covers temporary utilities, including electricity, lighting, telephone service, water, and sanitary facilities; temporary controls, including barriers, protection of work, and water control; and construction facilities, including parking, progress cleaning, and temporary buildings.

**1.2 TEMPORARY UTILITIES**

- A. Temporary Electricity: CONTRACTOR shall provide, maintain, and pay for all power required by CONTRACTOR, including electrical service to CONTRACTOR's and OWNER/ENGINEER's field offices.
- B. Temporary Lighting: CONTRACTOR shall provide all temporary lighting required for execution of his work and for employee and public safety. As a minimum, lighting levels during working hours shall meet the requirements of OSHA Subsection 1926.56 illumination.
- C. Temporary Heating and Cooling
  - 1. Provide heating and cooling devices as needed to maintain specified conditions for construction operations.
- D. Temporary Ventilation
  - 1. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- E. Temporary Water Service
  - 1. CONTRACTOR shall provide for all his workers on the project, adequate and reasonably convenient uncontaminated drinking water supply. All facilities shall comply with the regulations of the local and State Departments of Health.
  - 2. CONTRACTOR shall be responsible to arrange for water, both potable and non-potable water.
  - 3. When water is taken from a city water system or any other potable water supply source for construction purposes, suitable precautions shall be taken to prevent cross connections and contamination of the water supply.
- F. Temporary Sanitary Facilities: CONTRACTOR shall provide and maintain sanitary facilities for his employees and his subcontractors' employees that will comply with the regulations of the local and State Departments of Health.

**1.3 TEMPORARY CONTROLS**

- A. Barriers: Provide barriers as necessary to prevent unauthorized entry to construction areas and to protect existing facilities and adjacent properties from damage from

construction operations. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

B. Project Security

1. CONTRACTOR shall make all necessary provisions to protect the project and CONTRACTOR's facilities from fire, theft, and vandalism, and the public from unnecessary exposure to injury.
2. Entry Control:
  - a. Restrict entrance of persons and vehicles into Project site.
  - b. Allow entrance only to authorized persons.

C. Dust Control: Execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into the atmosphere. Give all unpaved streets, roads, detours, or haul roads used in the construction area an approved dust-preventive treatment or periodically water to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

D. Pest Control: Provide methods, means, and facilities to prevent rodents, pests, and insects from damaging the Work.

E. Pollution Control: Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations. All chemicals used during construction or furnished for project operation whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant or of other classification, shall show approval of the U.S. Department of Agriculture. Use of all such chemicals and disposal of residues shall be in strict accordance with the printed instruction of the manufacturer.

F. Protection of Work: CONTRACTOR shall protect installed work and provide special protection where specified in individual specifications sections. CONTRACTOR shall provide temporary and removable protection for installed products and shall control activity in immediate work area to minimize damage.

G. Open Burning: No open burning of waste materials will be allowed.

H. Explosives and Blasting: The use of explosives on the work will not be permitted.

I. Noise Abatement: In inhabited areas, particularly residential, operations shall be performed in a manner to minimize unnecessary noise generation.

J. STORM AND GROUND WATER

1. CONTRACTOR shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water entering the excavation or other parts of the work, whether the water be from surface or underground water sources.
2. In excavation, fill, and grading operations, care shall be taken to disturb the pre-existing drainage pattern as little as possible. Care shall be taken not to direct drainage water into private property or into streets or drainage ways inadequate for the increased flow.

3. CONTRACTOR shall maintain effective means to minimize the quantity of sediments leaving the work area either by storm water or CONTRACTOR's own dewatering operations. CONTRACTOR shall be responsible for obtaining required permits and complying with all City, State, and Federal storm water management regulations and requirements, including preparing and implementing a Storm Water Pollution Prevention Plan (SWPPP) for Construction Activities. If required, CONTRACTOR shall submit a copy of the Notice of Intent and the SWPPP to the OWNER for review and approval.

## **1.4 CONSTRUCTION FACILITIES**

### **A. VEHICULAR ACCESS**

1. Construct temporary access roads from public thoroughfares to serve construction area, of width and load bearing capacity to accommodate unimpeded traffic for construction purposes.
2. Extend and relocate vehicular access as Work progress requires, provide detours as necessary for unimpeded traffic flow.
3. Location of temporary access roads and detours shall be approved by ENGINEER.
4. Provide unimpeded access for emergency vehicles.
5. Provide and maintain access to fire hydrants and control valves free of obstructions.
6. Provide means of removing mud from vehicle wheels before entering streets.
7. When possible, use existing on-site roads for construction traffic.

- B. Parking: CONTRACTOR shall provide temporary parking areas to accommodate construction personnel. Parking shall be in an area approved by ENGINEER.

### **C. Progress Cleaning**

1. CONTRACTOR shall maintain areas free of waste materials, debris, and rubbish. Maintain the site in a clean and orderly condition. Upon completion of work, repair all damage caused by equipment and leave the project site free of rubbish or excess materials of any kind.
2. Thoroughly clean all spilled dirt, gravel, or other foreign materials caused by the construction operations from all streets and roads at the conclusion of each day's operation.
3. It shall be the responsibility of CONTRACTOR to promptly clean up and remove any oil and/or fuel spills caused by CONTRACTOR or his Sub-contractors during the project. Contaminated soil shall be properly disposed of by CONTRACTOR in accordance with all applicable laws. CONTRACTOR shall be responsible for any damages to OWNER resulting from CONTRACTOR's negligence in promptly cleaning up said spills.

## **1.5 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS**

- A. Prior to Final Application for Payment, CONTRACTOR shall remove temporary above grade or buried utilities, equipment, facilities, and materials; clean and repair damage caused by installation or use of temporary work; and restore existing facilities used during construction to original condition.

## 1.6 CULTURAL RESOURCES

- A. CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archeological, or cultural resources (hereinafter called "cultural resources").
- B. CONTRACTOR shall conform to the applicable requirements of the National Historic Preservation Act of 1966 as it relates to the preservation of cultural resources.
- C. If a suspected or unsuspected historical, archaeological, or paleontological item, feature, or site or other cultural resource is encountered during subsurface excavations at the site of construction, the following procedures shall be instituted:
  - 1. Construction operations shall be immediately stopped in the vicinity of the discovery and ENGINEER and OWNER shall be notified of the nature and exact location of the finding. CONTRACTOR shall not damage the discovered objects and shall provide written confirmation of the discovery to ENGINEER within two (2) calendar days.
  - 2. OWNER and ENGINEER will then immediately notify the State Historical Preservation Office (SHPO) and the Utah Geological Survey (UGS).
  - 3. SHPO and UGS will investigate the finding and determine if the resource requires protection and the disposition of the said resource.
- D. If SHPO and UGS determine that the potential find is a bona fide cultural resource, CONTRACTOR shall suspend work at the location of the find under the provisions for changes contained in Articles 11, 12, and 13 [EJCDC] or Articles 10, 11, and 16 [APWA] of Section 00 72 00 – General Conditions.

## PART 2 PRODUCTS

### 2.1 TEMPORARY EROSION CONTROL MATERIALS

#### A. EROSION CONTROL BLANKETS

- 1. Erosion control blankets shall meet the requirements of the Erosion Control Technology Council (ECTC) and the FHWA Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-03 Section 713.17 as a Type 3.B Extended Term Double Net Erosion Control Blanket. The erosion control blanket shall be fabricated from UV-stabilized polypropylene and a straw/coconut blend. The blanket shall be **Model SC150 by Tensar North American Green, Excel CS-3 by Western Excelsior**, or approved equal. The functional longevity shall be 24 months minimum.  
SILT FENCE
- 2. Use woven fabric meeting the following properties in Table 01 50 00-1.



<b>Table 01 50 00-1 - Silt Fence Geotextile</b>			
<b>Property</b>	<b>ASTM</b>	<b>MARV's</b>	
		<b>Standard</b>	<b>High Performance</b>
Grab Tensile Strength, lbs.	D 4632	90 <sup>(a)</sup>	120 <sup>(a)</sup>
Grab Elongation, %	D 4632	< 40	< 40
Flux, gal/min/ft <sup>2</sup>	D 4491	15	90
Apparent Opening Size, (AOS-US sieve)	D 4751	> 20	> 30
Ultraviolet Degradation, %	D 4355	70	90
<b>Notes:</b> (a) Percent of tensile strength retained determined after weathering per ASTM D 4355 for 500-hours			

3. High performance fence to have tape yarns in one principal direction only.
4. Add stabilizers or inhibitors to make the filaments resistant to sunlight or heat deterioration.
5. Finish edges to prevent outer yarn from pulling away from the fabric.
6. Sheets of fabric may be sewn or bonded together. Provide minimum width recommended by manufacturer.
7. No deviation from any requirement in Table 2 due to the presence of seams.
8. Manufactured with pockets for posts, hems with cord, or with posts pre-attached using staples or button head nails.

#### **B. POSTS**

1. Minimum length: 4-feet.
2. Steel: Round, U shaped, T shaped, or C shaped with a minimum weight of 1.3-pounds per foot and have projections for fastening wire.
3. Wood as follows:
  - a. Soft wood posts at least 3-inches in diameter, or nominal 2 x 4-inches and straight to provide a fence without noticeable misalignment.
  - b. Hard wood post with a minimum cross-sectional area of 2.25 square-inches.
4. Fasteners for Wooden Posts:
  - a. Wire staples No. 17 gage minimum with a crown at least 3/4-inches wide and legs at least 1/2-inch long.
  - b. Nails 14 gage minimum, 1-inch long with 3/4-inch button.

### **PART 3 EXECUTION**

#### **3.1 SILT FENCE**

- A. Beginning work means acceptance of existing conditions.

TEMPORARY CONSTRUCTION UTILITIES  
AND ENVIRONMENTAL CONTROLS

- B. Maintain the silt fence until revegetation is complete (defined as when cover reaches a density of at least 70% of pre-disturbance levels).
- C. Clear area of any debris and obstructions that may damage geotextile.
- D. Place post in all low points.
- E. Install posts a maximum of 8-feet apart with at least 18-inches in the ground. If not possible to achieve depth, secure posts to prevent overturning.
- F. Attach filter fabric by wire, cord, pockets, staples, nails, or other effective means.
  - 1. When using a wire support fence, provide at least 6 horizontal wires with a minimum of 12 gage wire. Space vertical wires 6-inches maximum. Secure geotextile to the up-slope side of the post. Extend wire into the trench a minimum of 2-inches and extend a maximum of 36-inches above the ground surface.
- G. Install fabric so 6 to 8-inches of fabric remain at the bottom to be buried. Splice together only at support posts with at least a minimum overlap of 18-inches. Extend buried portion 6-inches deep and the rest upstream of the fabric fence.
- H. Sediment Removal: Remove sediment before deposit reaches 1/2 of the height of the silt fence or raise the height of silt fence. After removal of sediment, dress landscape.
- I. Schedule of Locations: Typical locations include the toe of fill slopes, the downhill side of fill slopes, the downhill side of large cut areas, and natural drainage areas. Limit geotextile materials to handle an area equivalent to 1,000 square feet per 10-feet of fence. Use caution should the site slope be steeper than 1:1 (horizontal to vertical), and water flow rates exceed 1 cubic foot per second per 10-feet of fence face.

- END OF SECTION -

**SECTION 01 50 30**  
**PROTECTION OF EXISTING FACILITIES**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Any existing facilities, disturbed which are located in or adjacent to the line of work such as curbs, gutters, drive approaches, sidewalks, driveways, fences, underground pipes, conduits, or utilities, shall be cleaned up and restored in kind by CONTRACTOR and in accordance with the Specifications contained herein governing the various types of services involved.
- B. CONTRACTOR shall not perform work that would affect any oil, gas, sewer, or water pipeline; any telephone, fiber optic, television cable, or electric transmission line; any fence; or any structure, until authorization has been obtained from owner of the improvement. Provide owner of the improvement due notice of the beginning of the work, and remove, shore, support, or otherwise protect such improvement or replace the same.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:

Section 01 78 50 Project Closeout

**1.3 RESTORATION OF FENCES**

- A. Where it is necessary to remove any fence to facilitate CONTRACTOR's operation, CONTRACTOR shall obtain prior agreement with the owner of the fence for removal of the fence and shall be responsible for any damage due to negligence of CONTRACTOR. As soon as practical, the fence shall be restored substantially to the same or improved condition as it was prior to the commencement of the work. Where livestock is present CONTRACTOR shall provide temporary fencing to keep livestock away from the construction area.

**1.4 UNDERGROUND SERVICE ALERT**

- A. Prior to any excavation in the vicinity of any existing underground facilities, including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities; and all roadway and state highway rights-of-way, CONTRACTOR shall notify the regional notification center (Blue Stakes of Utah) at 1-800-662-4111 or 811 or submit an on-line request at [www.bluestakes.org](http://www.bluestakes.org) at least 2 days, but no more than 7 days, prior to such excavation.

**1.5 INTERFERING STRUCTURES AND UTILITIES**

- A. CONTRACTOR shall exercise all possible caution to prevent damage to existing structures and utilities, whether above ground or underground. Prior to submittal of Shop Drawings, and prior to commencing any excavations for new pipelines or structures, conduct investigations, including exploratory excavations and borings, to

determine the location and type of underground utilities and services connections that could result in damage to such utilities. It shall be the responsibility of CONTRACTOR to locate and expose all existing underground and overhead structures and utilities in such a manner as to prevent damage to same. CONTRACTOR shall notify all utility offices concerned at least 48 hours in advance of construction operations in which a utility agency's facilities may be involved. This shall include, but not be limited to, irrigation water, culinary water, telephone, television cables, fiber optic communication, gas, and electric. CONTRACTOR shall be responsible for any and all changes to, reconnections to public utility facilities encountered or interrupted during prosecution of the work, and all costs relating hereto shall be at CONTRACTOR's expense. CONTRACTOR shall contract with and pay Public Utility Agencies for work required in connection with all utility interferences and handle all necessary notifications, scheduling, coordination, and details. The cost of public utility interferences shall be included in CONTRACTOR's lump sum or unit price bid covering the major contract facility to which interference or changes are attributable.

- B. All exploratory excavations shall be performed as soon as practicable after Notice to Proceed and, in any event, a sufficient time in advance of the construction to avoid possible delays to CONTRACTOR's progress. Prepare a report identifying each utility by its size, elevation, station, and material of construction. Immediately notify ENGINEER and the utility in writing as to any utility discovered in a different position than as marked in the field or shown on the Drawings, or any utility which is not marked in the field or not shown on the Drawings.
- C. The number of exploratory excavations required shall be that number which is sufficient to determine the alignment and grade of the utility. Conform to local agency requirements for backfill and pavement repair after performing exploratory excavations.
- D. Any damage to private property, either inside or outside the limits of the easements provided by OWNER, shall be the responsibility of CONTRACTOR. Any roads, structures, or utilities damaged by the work shall be repaired or replaced in a condition equal to or better than the condition prior to the damage. Such repair or replacement shall be accomplished at CONTRACTOR's expense without additional compensation from OWNER.
- E. CONTRACTOR shall remove and replace small miscellaneous structures such as fences and culverts which are damaged by the construction activity at his own expense without additional compensation from OWNER. CONTRACTOR shall replace these structures in a condition as good as or better than their original condition.
- F. At points where CONTRACTOR's operations are adjacent to or across properties of railway, telegraph, telephone, irrigation canal, power, gas, water, or adjacent to other property (damage to which might result in considerable expense, loss, and inconvenience), no work shall be started until all arrangements necessary for the protection thereof have been made.
- G. The locations of the major existing culinary water lines, gas pipes, underground electric, cable television, and telephone lines that are shown on the plans were taken from city maps, and maps supplied by the utility owner. No excavations were made to verify the locations shown for underground utilities, unless specifically stated on the Contract Drawings. It should be expected that some location discrepancies will occur. Neither OWNER nor its officers or agents shall be responsible for damages to CONTRACTOR

as a result of the locations of the utilities being other than those shown on the plans or for the existence of utilities not shown on the plans.

- H. CONTRACTOR shall be solely and directly responsible to owners and operators of such properties for any damage, injury, expense, loss or inconvenience, delay, suits, actions, or claims of any character brought because of an injury or damage which may result from the carrying out of the work to be done under the contract.
- I. All utilities including all water, sewer, storm drain, gas, petroleum products, or other pipelines; all buried electric power, communications, or television cables; all traffic signal and street lighting facilities encountered along the line of the work shall remain continuously in service during all operations under the Contract, unless other arrangements satisfactory to ENGINEER are made with owner of said utility.
- J. In the event of interruption to either domestic or irrigation water, or to other utility services as a result of accidental breakage, or as a result of being exposed or unsupported, CONTRACTOR shall promptly notify the proper authority. CONTRACTOR shall cooperate with the authority in restoration of service as soon as possible and shall not allow interruption of any water or utility service outside working hours unless prior approval is received.
- K. In case it shall be necessary to move the property of any public utility or franchise holder, such utility company or franchise holder will, upon request of CONTRACTOR, be notified by OWNER to move such property within a specified reasonable time. When utility lines that are to be moved are encountered within the area of operations, CONTRACTOR shall notify ENGINEER a sufficient time in advance for the necessary measures to be taken to prevent interruption of service.
- L. Where the proper completion of the WORK requires the temporary or permanent removal and/or relocation of an existing Utility or other improvement which is indicated, CONTRACTOR shall remove and, without unnecessary delay, temporarily replace or relocate such Utility or improvement in a manner satisfactory to ENGINEER and OWNER of the facility. In all cases of such temporary removal or relocation, restoration to the former location shall be accomplished by CONTRACTOR in a manner that will restore or replace the Utility or improvement as nearly as possible to its former locations and to as good or better condition than found prior to removal.

#### **1.6 RIGHTS-OF-WAY**

- A. CONTRACTOR shall be required to confine construction operations within the dedicated rights-of-way for public thorough fares, or within areas for which construction easements have been obtained, unless they have made special arrangements with the affected property owners in advance. CONTRACTOR shall be required to protect stored materials, cultivated trees and crops, and other items adjacent to the proposed construction site.
- B. CONTRACTOR shall submit for approval by ENGINEER the type and size of equipment used, and the methods for work performed on the rights-of-way across private properties, to avoid or minimize injury to trees, shrubs, gardens, lawns, fences, driveways, retaining walls, or other improvements within the rights-of-way.

- C. The construction easement widths and access to private properties are as shown on the Drawings and as described in the easement documents; however, CONTRACTOR is to minimize impacts to surface improvements within the right-of-way. CONTRACTOR shall obtain a signed release from the property owner, approving restoration of work in the construction easements across or bordering private properties. See Project Closeout Section 01 78 50, 1.4.D.
- D. Property owners affected by the construction shall be notified by CONTRACTOR at least 48 hours in advance of the time the construction begins. During all construction operations, CONTRACTOR shall construct and maintain such facilities as may be required to provide access by all property owners to their property. No person shall be cut off from access to his property for a period exceeding 8 hours unless CONTRACTOR has made special arrangements with the affected persons. CONTRACTOR shall, daily or more frequently, if necessary, grade all disturbed areas to be smooth for motor vehicle traffic.

## **1.7 PROTECTION OF SURVEY, STREET OR ROADWAY MARKERS**

- A. CONTRACTOR shall not destroy, remove, or otherwise disturb any existing survey markers or other existing street or roadway markers without proper authorization. No pavement breaking or excavation shall be started until all survey or other permanent marker points that will be disturbed by the construction operations have been properly referenced. Survey markers or points disturbed by CONTRACTOR shall be accurately restored after street or roadway resurfacing has been completed.

## **1.8 TREES OR SHRUBS WITHIN PROJECT LIMITS**

- A. Except where trees or shrubs are indicated to be removed, CONTRACTOR shall exercise all necessary precautions so as not to damage or destroy any trees or shrubs, including those lying within street rights-of-way and project limits, and shall not trim or remove any trees unless such trees have been approved for trimming or removal by the jurisdictional agency or OWNER. Existing trees and shrubs which are damaged during construction shall be trimmed or replaced by CONTRACTOR or a certified tree company under permit from the jurisdictional agency and/or OWNER. Tree trimming and replacement shall be accomplished in accordance with the following paragraphs.
  - 1. The symmetry of the tree shall be preserved; no stubs or splits or torn branches left; clean cuts shall be made close to the trunk or large branch. Spikes shall not be used for climbing live trees. Cuts over 1-1/2 inches in diameter shall be coated with a tree paint product that is waterproof, adhesive, and elastic, and free from kerosene's, coal tar, creosote, or other material injurious to the life of the tree.
  - 2. CONTRACTOR shall immediately notify the jurisdictional agency and/or OWNER if any tree or shrub is damaged by CONTRACTOR's operations. If, in the opinion of said agency or OWNER, the damage is such that replacement is necessary, CONTRACTOR shall replace the tree or shrub at its own expense. The tree or shrub shall be of a like size and variety as the one damaged, or, if of a smaller size, CONTRACTOR shall pay to OWNER of said tree a compensatory payment acceptable to the tree or shrub owner, subject to the approval of the jurisdictional agency or OWNER. The size of the tree or shrub shall be not less than 1-inch diameter nor less than 6 feet in height.

## **1.9 RESTORATION OF PAVEMENT**

- A. Pavement work shall meet the specifications for installation as noted in APWA Section 33 12 16.
- B. All paved areas damaged during construction shall be replaced with similar materials of equal thickness to match the existing adjacent undisturbed areas, except where specific resurfacing requirements have been called for in the Contract or in the requirements of the agency issuing the permit. The pavement restoration requirement to match existing sections shall apply to all components of existing sections, including sub-base, base, and pavement. Pavements which are subject to partial removal shall be neatly sawcut in straight lines.
- C. Wherever required by the local agency having jurisdiction, CONTRACTOR shall place temporary surfacing promptly after backfilling and shall maintain such surfacing for the period of time fixed by said authorities before proceeding with the final restoration of improvements.

## **1.10 CONCRETE WORK**

- A. Concrete work shall meet the specifications for installation as noted in APWA Section 32 16 13 Driveway, Sidewalk, Curb and Gutter.
- B. All flat work in streets tying into existing flatwork shall be doweled into the existing concrete. Dowels to be spaced at 12" O.C. and be No. 5 rebar x 14" for slabs up to 8 inches in thickness and No. 8 rebar x 18" for slabs over 8 inches.

## **1.11 LAWNS**

- A. Lawns that are damaged or destroyed during performance of the work shall be repaired or replaced with turf sod according to APWA Section 32 92 00 - Turf and Grass.

## **1.12 FENCES**

- A. Fences that are damaged or destroyed during performance of the work shall be repaired or replaced back to the original condition or better to the satisfaction of the landowner and OWNER.

## **1.13 LANDSCAPING**

- A. All landscaping on private property that is damaged or destroyed during performance of the work shall be repaired or replaced back to the original condition or better to the satisfaction of the landowner and OWNER.

## **1.14 OTHER SURFACE IMPROVEMENTS**

- A. All other surface improvements not explicitly mentioned herein that are damaged or destroyed during performance of the work shall be repaired or replaced back to original condition or better.

**PART 2 PRODUCTS (Not Used)**

**PART 3 EXECUTION (Not Used)**

- END OF SECTION -



**SECTION 01 56 00**  
**DUST CONTROL**

**PART 1 GENERAL**

**1.1 SCOPE OF WORK**

- A. Furnish all labor, materials, and equipment as required to provide dust control for the project.
- B. All materials and services shall comply with the requirements of the State of Utah, Department of Environmental Quality, Division of Air Quality and the City's Municipal Code.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Water: CONTRACTOR shall be responsible to arrange and pay for water for dust control.
- B. Calcium chloride shall be added to the water used to provide dust control, if required by the City or agency having jurisdiction.

**PART 3 EXECUTION**

**3.1 DUST CONTROL**

- A. CONTRACTOR shall comply with the requirements of the State of Utah Department of Environmental Quality, Air Quality Regulations (including R301-205 Emission Standards: Fugitive Emissions and Fugitive Dust, and R307-309 Fugitive Emissions and Fugitive Dust, of the Utah Air Conservation Rules (UACR). CONTRACTOR shall submit a Fugitive Dust Control Plan to the Utah Division of Air Quality, which meets the requirements of R307-309-4. CONTRACTOR shall obtain a permit from the Division of Air Quality.
- B. CONTRACTOR shall execute Work by methods to minimize raising dust from construction operations. Provide positive means to prevent air-borne dust from dispersing into the atmosphere. Give all unpaved streets, roads, detours, or haul roads used in the construction area an approved dust-preventive treatment or periodically water to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

**3.2 WATER PLACEMENT FOR DUST CONTROL**

- A. CONTRACTOR is responsible for placement of sufficient water to control dust on the project. Dust control is defined by the permit requirements of the State of Utah, Division of Environmental Quality, Division of Air Quality. Permit shall be obtained by CONTRACTOR.

### **3.3 WATER AND CALCIUM CHLORIDE MIXTURE FOR DUST CONTROL**

- A. CONTRACTOR may also use a water and calcium chloride solution to abate the dust for the project. The mixture of calcium chloride per 10,000-gallon truck shall be 10 pounds. The calcium chloride shall be added to the water truck container as the water is being put into the water truck in order to provide sufficient mixing.
- B. In the absence of providing the water and calcium chloride mixture, CONTRACTOR shall meet the requirements of Subsection 3.2 of this document, or shall use other approved methods by OWNER that will allow CONTRACTOR to meet permit requirements.

- END OF SECTION -

**SECTION 01 60 00**  
**PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

**1.1 PRODUCTS**

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.
- C. Furnish interchangeable components from same manufacturer for components being replaced.

**1.2 PRODUCT DELIVERY REQUIREMENTS**

- A. Transport and handle products in accordance with manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

**1.3 PRODUCT STORAGE AND HANDLING REQUIREMENTS**

- A. Store and protect products in accordance with manufacturers' instructions.
- B. Store with seals and labels intact and legible.
- C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.
- D. For exterior storage of fabricated products, place on sloped supports above ground.
- E. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- F. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- G. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- H. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

**1.4 PRODUCT OPTIONS**

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

- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and meeting specifications, no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

## **1.5 PRODUCT SUBSTITUTION PROCEDURES**

- A. ENGINEER will consider requests for Substitutions only after Notice of Award.
- B. Substitutions may be considered when a product becomes unavailable through no fault of CONTRACTOR.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that CONTRACTOR:
  - 1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  - 2. Will provide same warranty for Substitution as for specified product.
  - 3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to OWNER.
  - 4. Waives claims for additional costs or time extension which may subsequently become apparent.
  - 5. Will reimburse OWNER for review or redesign services associated with re-approval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
  - 1. Submit four copies of request for Substitution for consideration to ENGINEER.
  - 2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
  - 3. ENGINEER may require CONTRACTOR to provide additional data about the proposed substitution.
  - 4. ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and ENGINEER's decision shall be final.
  - 5. ENGINEER will notify CONTRACTOR in writing of decision to accept or reject request.
  - 6. Acceptance by ENGINEER of a substitution proposed by CONTRACTOR shall not relieve CONTRACTOR of the responsibility for full compliance with the Contract Documents and for the adequacy of the substitution.

## **PART 2 PRODUCTS (Not Used)**

## **PART 3 EXECUTION (Not Used)**

- END OF SECTION -

**SECTION 01 78 50**  
**PROJECT CLOSEOUT**

**PART 1 GENERAL**

**1.1 FINAL CLEANUP**

- A. CONTRACTOR shall promptly remove from the vicinity of the completed Work all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the Work by OWNER will be withheld until CONTRACTOR has satisfactorily complied with the foregoing requirements for final cleanup of the Project Site.

**1.2 TOUCH-UP AND REPAIR**

- A. CONTRACTOR shall touch up or repair all finished surfaces on structures, equipment, fixtures, etc., that have been damaged prior to final acceptance. Surface on which such touch-up or repair cannot be successfully accomplished shall be completely refinished or in the case of hardware and similar small items, the item shall be replaced.

**1.3 CLOSEOUT TIMETABLE**

- A. CONTRACTOR shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow OWNER, ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

**1.4 MAINTENANCE AND GUARANTEE**

- A. CONTRACTOR shall comply with the maintenance and guarantee requirements contained in Article 6.16 of the General Conditions, Section 00 72 00.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as part of such required repair work, and any repair or resurfacing which becomes necessary by reason of such required repair work shall be completed by CONTRACTOR at no cost to OWNER.
- C. CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from OWNER. If CONTRACTOR fails to make such repairs or replacement promptly, OWNER reserves the right to do the work and CONTRACTOR and his surety shall be liable to OWNER for the cost thereof.
- D. CONTRACTOR shall obtain a signed release from the property owner approving restoration of work in the construction easements across or bordering private property.

**1.5 BOND**

- A. CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and Article 5 of the General Conditions, Section 00 72 00.

## **1.6 FINAL ACCEPTANCE**

- A. Final acceptance and final payment shall not be made until all provisions of the General Conditions Section 00 72 00 Article 14.9 have been satisfied.

## **1.7 PROJECT RECORD DOCUMENTS**

- A. Maintain on site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other modifications to the Contract.
  - 5. Reviewed Shop Drawings, Product Data, and Samples.
  - 6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by OWNER.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
  - 1. Manufacturer's name and product model and number.
  - 2. Product substitutions or alternates utilized.
  - 3. Changes made by Addenda and modifications.
- F. Record Drawings: Legibly mark each item to record actual construction including:
  - 1. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - 2. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  - 3. Field changes of dimension and detail
  - 4. Details not on original Contract drawings
- G. Submit documents to ENGINEER with claim for final Application for Payment.

## **1.8 CONTRACT CLOSEOUT**

- A. As a condition precedent to final acceptance of the project, CONTRACTOR shall complete the following forms and submit the original and two copies of each form to the Project Representative.
  - 1. Contractor's Certificate of Substantial Completion
  - 2. Contractor's Certificate of Final Completion
  - 3. Contractor's Final Waiver of Lien
  - 4. Consent of Surety for Final Payment
  - 5. Affidavit of Payment
  - 6. Affidavit of Release of Liens by the Contractor

**PART 2 PRODUCTS (Not Used)**

**PART 3 EXECUTION (Not Used)**

**CONTRACTOR'S CERTIFICATE OF SUBSTANTIAL COMPLETION**

OWNER

TO: SALT LAKE CITY DEPARTMENT OF PUBLIC UTILITIES  
1530 S West Temple Street  
Salt Lake City, UT 84115

PROJECT: \_\_\_\_\_

ATTENTION: \_\_\_\_\_

FROM: \_\_\_\_\_  
Firm or Corporation

This is to certify that I, \_\_\_\_\_ am an authorized official of \_\_\_\_\_  
\_\_\_\_\_ working in the capacity of \_\_\_\_\_  
\_\_\_\_\_ and have been properly authorized by said form or corporation to sign the following statements  
pertaining to the subject contract.

I know of my own personal knowledge, and do hereby certify, that the work of the Contract described above has been substantially performed, and materials used and installed to date in accordance with, and in conformity to, the Contract drawings and specifications. A list of all incomplete work is attached.

The Contractor hereby releases the Owner and its agents from all claims and liability to the Contractor for anything done or finished for or relating to the Work, as specified in the Project Manual, except demands against the Owner for the remainder of progress payments retained to date, and unresolved written claims prior to this date.

The Contract Work is now substantially complete, ready for its intended use, and ready for your inspection. You are requested to issue a Certificate of Substantial Completion.

Signature: \_\_\_\_\_

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



## CONTRACTOR'S CERTIFICATE OF FINAL COMPLETION

OWNER

TO:

SALT LAKE CITY DEPARTMENT OF PUBLIC UTILITIES  
1530 S West Temple Street  
Salt Lake City, UT 84115

PROJECT: \_\_\_\_\_

ATTENTION: \_\_\_\_\_

FROM: \_\_\_\_\_  
Firm or Corporation

This is to certify that I, \_\_\_\_\_ am an authorized official of \_\_\_\_\_  
\_\_\_\_\_ working in the capacity of \_\_\_\_\_  
and have been properly authorized by said form or corporation to sign the following statements  
pertaining to the subject contract.

I know of my own personal knowledge, and do hereby certify, that the work of the Contract  
described above has been substantially performed, and materials used and installed to date in  
accordance with, and in conformity to, the Contract drawings and specifications.

The Contractor hereby releases the Owner and its agents from all claims and liability to the  
Contractor for anything done or finished for or relating to the Work. The Contract Work is now  
complete in all parts and requirements, ready for its intended use, excepting the attached list of  
minor deficiencies and the reason for each being incomplete to date, for which exemption from final  
payment requirements is requested (if no exemptions requested, write "none") \_\_\_\_\_.  
\_\_\_\_\_. The Work is now ready for your final inspection. The following items are  
required from the Contractor prior to application for final payment and are submitted herewith, if  
any:

\_\_\_\_\_  
\_\_\_\_\_

I understand that neither the issuance, by the Owner, or a Certificate of Final Completion, nor the  
acceptance thereof by the Owner, shall operate as a bar claim against the Contractor under the  
terms of the guarantee provisions of the Contract Documents.

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

## CONTRACTORS FINAL WAIVER OF LIEN

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has furnished labor and materials for (A) \_\_\_\_\_  
in the City of \_\_\_\_\_, County of \_\_\_\_\_, State of Utah, of which City of \_\_\_\_\_ is the Owner.

NOW THEREFOR, this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_, for and in consideration of the sum of (B) \_\_\_\_\_ dollars paid simultaneously herewith, the receipt whereof is hereby acknowledged by the undersigned, the undersigned does hereby waive and release any lien\* right to, or claim of lien with respect to and on said above described premises, and the improvements thereon, and on the monies or other consideration due or to become due from the Owner, on account of labor, services, materials, fixtures, apparatus or machinery heretofore or which may hereafter be furnished by the undersigned to or for the above described premises by virtue of said contract.

(C) \_\_\_\_\_ (SEAL)  
(Name of sole ownership, corporation or partnership)

(C) \_\_\_\_\_ (SEAL)  
(Signature of Authorized Representative)

Title: \_\_\_\_\_

### INSTRUCTION FOR FINAL WAIVER:

- A. Project name.
- B. Final Contract amount received (total amount of Contract as adjusted).
- C. If the waiver is for a corporation, corporate name should be used, corporate seal affixed, and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself/herself as partner.

\* The word Lien as used herein shall include Stop Orders, Stop Notices, or Freeze Orders on monies or other consideration of the Owner which are due or are to become due on the Contract referenced above.

## CONSENT OF SURETY FOR FINAL PAYMENT

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

Location: \_\_\_\_\_

Type of Contract: \_\_\_\_\_

Amount of Contract: \_\_\_\_\_

In accordance with the provisions of the above named contract between the Owner and the Contractor,  
the following named surety:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

on the Payment Bond of the following named Contractor:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

hereby approves of final payment to the Contractor, and further agrees that said final payment to the  
Contractor shall not relieve the Surety Company named herein of any of its obligations to the following  
named Owner (as set forth in said Surety Company's bond):

SALT LAKE CITY DEPARTMENT OF PUBLIC UTILITIES  
1530 S West Temple Street  
Salt Lake City, UT 84115

IN WITNESS WHEREOF, the Surety Company has hereunto set its hand and seal this \_\_\_\_\_ day of \_\_\_\_  
\_\_\_\_\_, 20\_\_\_\_.

\_\_\_\_\_  
(Name of Surety Company)

\_\_\_\_\_  
(Signature of Authorized Representative)

Title: \_\_\_\_\_

## AFFIDAVIT OF PAYMENT

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has been employed by SALT LAKE CITY DEPARTMENT OF PUBLIC UTILITIES to furnish labor and materials under a contract dated \_\_\_\_\_ for the project named \_\_\_\_\_ in the City of \_\_\_\_\_ County of \_\_\_\_\_, State of Utah.

NOW THEREFORE, this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, the undersigned, as the Contractor for the above named Contract pursuant to the conditions of the Contract, hereby certifies that, except as listed below, he has paid in full or has otherwise satisfied all obligations for all materials and equipment furnished, for all work, labor, and services performed, and for all known indebtedness and claims against the Contractor for damages arising in any manner in connection with the performance of the Contract referenced above for which the Owner or its property might in any way be held responsible.

EXCEPTIONS: (If none, write "none". If required by the Owner, the Contractor furnish bond satisfactory to the Owner for each exception).

{AFFIX CORPORATE} \_\_\_\_\_  
{SEAL HERE} Contractor (Name of sole ownership,  
Corporation or partnership)

\_\_\_\_\_  
(Signature of Authorized Representative)

Title: \_\_\_\_\_

## AFFIDAVIT OF RELEASE OF LIENS BY THE CONTRACTOR

TO ALL WHOM IT MAY CONCERN:

WHEREAS, the undersigned has been employed by SALT LAKE CITY DEPARTMENT OF PUBLIC UTILITIES to furnish labor and materials under a contract dated \_\_\_\_\_ for the project named \_\_\_\_\_ in the City of \_\_\_\_\_ County of \_\_\_\_\_ State of Utah.

NOW THEREFOR, this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_, the undersigned, as the Contractor for the above named Contract pursuant to the conditions of the Contract, hereby certifies that to the best of his/her knowledge, information and belief, except as listed below, the Releases or Waivers of Lien\* attached hereto include the Contractor, all subcontractors, all suppliers of material and equipment, and all performers of work, labor or services, who have or may have liens against any property of the Owner and on the monies or other consideration due to becomes due from the Owner arising in any manner in connection with the performance of the Contract referenced above.

EXCEPTIONS: (If none, write "none". If required by the Owner, the Contractor furnish bond satisfactory to the Owner for each exception).

ATTACHMENTS:

1. Contractor's Release or Waiver of Liens, conditional upon receipt of final payment.
2. Separate Release or Waiver of Liens from subcontractors and material suppliers.

{AFFIX CORPORATE} \_\_\_\_\_  
{SEAL HERE} Contractor (Name of sole ownership,  
Corporation or partnership)

\_\_\_\_\_  
(Signature of Authorized Representative)

Title: \_\_\_\_\_

\* The word Lien as used herein shall include Stop Orders, Stop Notices, or Freeze Orders on monies or other consideration of the Owner which are due or are to become due on the Contract referenced above.

- END OF SECTION -

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**SECTION 02 41 00**  
**DEMOLITION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. Section Includes:
  - 1. Demolishing designated structures and piping
  - 2. Demolishing designated foundations
  - 3. Disconnecting and capping designated utilities
  - 4. Removing demolished materials
- B. See Electrical Specifications for required demolition of electrical equipment.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 31 23 23 Excavation and Backfill for Structures

**1.3 SUBMITTALS**

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings and Schedule: Describe demolition, removal procedures, sequence and schedule.
- C. Submit existing structure monitoring procedures.
- D. Design Data: Submit calculations for bracing, shoring, and underpinning to protect structures indicated to remain signed and sealed by professional engineer.

**1.4 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of capped utilities and any changes to the design.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. Fill materials shall be in accordance with DIVISION 31 – EARTHWORK or as noted on the Contract Drawings.
- B. Structural and piping modifications shall include the materials noted in the specific Sections related to the changes.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Document condition of adjacent structures and buildings indicated to remain.
- B. Monitor buildings for movement during demolition operations. Notify ENGINEER of measured movement.

### **3.2 PREPARATION**

- A. Contact OWNER not less than three working days before performing Work.
  - 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Provide, erect, and maintain temporary barriers and security devices.
- C. Notify adjacent owners of work which may affect their property, potential noise, utility outage, or disruption seven days prior to the start of Work. Coordinate with Owner.
- D. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
- E. Protect existing structures indicated to remain.

### **3.3 DEMOLITION REQUIREMENTS**

- A. Conduct demolition to minimize interference with adjacent structures.
- B. Conduct operations with minimum interference to public or private access.
- C. Maintain egress and access at all times. Do not close or obstruct roadways without permits.
- D. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and debris rising and scattering in the area. CONTRACTOR shall comply with local, State, and Federal environmental regulations pertaining to environmental protection. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.
- E. Cease operations immediately when adjacent structures appear to be in danger. Notify OWNER and ENGINEER.

### **3.4 STRUCTURE DEMOLITION**

- A. Disconnect, remove as required, and cap designated utilities. Identify utilities at termination of demolition. Record termination or capped location on Record Documents.
- B. Remove the existing piping as noted on the drawing. Remove the existing concrete floor in areas that require new equipment or conduits.
- C. Demolish and remove components in an orderly and careful manner.



- D. Backfill all excavated areas and open pits or holes resulting from demolition with structural fill materials in accordance with Section 31 23 23 Excavation and Backfill for Structures.
- E. Grade and compact areas affected by demolition to required finished grades.
- F. Protect all existing structures not to be removed.

### **3.5 CLEAN UP**

- A. Remove demolished materials from site as work progresses.
- B. Leave areas of work in clean condition.
- C. Adjacent structures shall be cleaned of dust, dirt, and debris caused by the demolition, as requested by ENGINEER or directed by governing authorities, and adjacent areas shall be returned to pre-demolition conditions.

- END OF SECTION -

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**SECTION 03 10 00**  
**CONCRETE FORMING AND ACCESSORIES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section covers the work necessary to furnish, install, and complete, the concrete formwork.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:

- |                     |                        |
|---------------------|------------------------|
| 1. Section 01 33 00 | Submittal Procedures   |
| 2. Section 03 30 00 | Cast-in-Place Concrete |

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
1. American Concrete Institute (ACI) -ACI 347R- Guide to Formwork for Concrete
  2. American Hardboard Association (AHA) -AHA A135.4- Basic Hardboard
  3. Department of Commerce (DOC) -DOC PS 1- Structural Plywood
  4. ACI 350R-01 – Code Requirements for Environmental Engineering Concrete Structures and Commentary
  5. NSF International (NSF) 61 - Drinking Water System Components - Health Effects

**1.4 DESIGN**

- A. Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the finish specified in Section 03 30 00 Cast-in-Place Concrete. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

**1.5 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. The following shall be submitted:
1. Drawings showing details of forming, shoring and bracing for footings, walls, and floors shall be submitted to ENGINEER at least 3 weeks prior to their use. Drawings showing details of formwork shall include joints, supports, studding and shoring, and sequence of form and shoring removal.
  2. If requested by ENGINEER, design analysis and calculations shall be submitted for form design and methodology used in the design. The analysis and calculations shall verify the selection of form ties, horizontal and vertical stiff-backs or braces for wall panels, forming and form openings, or any other part of forming, shoring or bracing which may be considered critical by ENGINEER.

3. Manufacturer's data including literature describing form materials, accessories, and form releasing agents.
  4. Manufacturer's recommendation on method and rate of application of form releasing agent.
- C. ENGINEER's review will not relieve CONTRACTOR from any responsibility as to the adequacy of the forming, shoring and bracing design. Any formwork installed by CONTRACTOR shall be solely at CONTRACTOR's risk. ENGINEER's review will not lessen or diminish CONTRACTOR's liability.

## PART 2 PRODUCTS

### 2.1 FORM MATERIALS

- A. Form surfaces shall be in "new and undamaged" condition and may be plywood, hard plastic finished plywood, overlaid waterproof particle board, and steel of sufficient strength and surface smoothness to produce the specified finish. CONTRACTOR shall verify that his types of form surfaces and panel sizes satisfy all requirements of these specifications.
- B. The wall form design shall be such that wall sections can be poured full height without creating horizontal cold joints and without causing snapping of form ties which shall be of sufficient strength and number to prevent spreading of the forms during the placement of concrete and which shall permit ready removal of the forms without spalling or damaging the concrete.

### 2.2 FORM TIES

- A. Form ties on exposed surfaces shall be located in a uniform pattern. Snap ties shall not be broken until the concrete has reached the design concrete strength. The use of tie wires as form ties will not be permitted. Snap ties, designed so that the ends must be broken off before the forms can be removed, shall not be used. Form ties shall be **Plastic Cone Snap Tie by Dayton-Superior, Wrench Head Snap Tie by MASCO Mason Supply**, or approved equal.
- B. Taper ties with plastic or rubber plugs of an approved and proven design may also be used. The plugs must be driven into the hole with a steel rod, placed in a cylindrical recess made therefore in the plug. At no time shall plugs be driven on the flat area outside the cylindrical recess. Taper ties shall be **Taper Tie by Dayton-Superior, Taper-Tie by MASCO Mason Supply**, or approved equal.
- C. Waterstop for Tie Rods: For hydraulic structures and below grade structures, furnish on of the following:
  1. Provide hydrophilic waterstop to seal form tie rods. Waterstop shall be **Adeka Ultra-C Rings, BeSealed Sealing UFO**, or approved equal.
- D. Taper Tie Plug:

1. Design and size of the plug shall allow insertion with the insertion tool to elongate the plug while inserting and which will return to the approximate original size to form a watertight seal. Plug shall be soft PVC or EPDM and rated for a minimum hydrostatic pressure of 275 feet. The manufacturer shall be **Dayton Superior A58 Sure Plug, Sika X-Plug, Corkjoint CJ**, or approved equal.

## **2.3 FORM RELEASING AGENTS**

- A. Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03 30 00 Cast-in-Place Concrete. Forms shall be used, whenever necessary, to confine the concrete, to shape the concrete to the required lines and grades, and to obtain a thoroughly compacted dense concrete through proper vibrating. The forms shall have sufficient strength and rigidity to hold the concrete and to withstand the necessary pressure, tamping and vibration, without deflection from the prescribed lines. Where forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface so as to obtain accurate alignment of the surface and to prevent leakage of mortar.
- B. The surfaces of all forms in contact with the concrete shall be clean, rigid, tight and smooth. All dirt, chips, sawdust, mud, water and other foreign matter shall be removed from within the forms or within the excavated areas, before any concrete is deposited therein.
- C. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be thoroughly cleaned of mortar from previous concreting and of all other dirt and foreign matter before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.
- D. Bulkheads to form vertical wall joints shall be strong enough to withstand concrete pressures during pouring and vibrating, and shall be properly placed between the forms to avoid mortar seepage. Holes shall be provided in the bulkheads to permit passage of horizontal mild steel reinforcing where required by the Contract Drawings. Unless these are specifically called for on the Contract Drawings, no chamfer strips shall be placed in the corners of vertical construction joints.

### **3.2 COATING**

- A. Form inside surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing

concrete.

### 3.3 TAPER TIE PLUG

- A. Insert the PVC Plug in accordance with the manufacturer's written instructions using the manufacturer's insertion tool. After insertion fill both sides with non-shrink grout.

### 3.4 ALIGNMENT AND TOLERANCES

Forms shall be properly aligned and adequately supported to produce concrete surfaces conforming to construction tolerance given in Table 03 10 00-1 - Tolerances for Formed Surfaces.

TABLE 03 10 00-1  
TOLERANCES FOR FORMED SURFACES

Condition	Measurement	Tolerance
1. Variations from the plumb:	In any 10 feet of length	1/4-inch
a. In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length	1-inch
b. For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 20 feet of length Maximum for entire length	1/4-inch 1/2-inch
2. Variation from the level or from the grades indicated on the drawings	In any 10 feet of length In any bay or in any 20 feet of length	1/4-inch 3/8-inch
3. Variation of the linear building lines from established position in plan	In any 20 feet Maximum	1/2-inch 1-inch
4. Variation of distance between walls, columns, partitions	1/4-inch per 10 feet of distance, but not more than 1/2-inch in any one bay, and not more than 1-inch total variation	
5. Variation in the thickness of slabs and walls	Minus Plus	1/4-inch 1/2-inch

### 3.5 FORM REMOVAL

- A. Forms shall be removed in a manner that will prevent injury to the concrete and ensure the complete safety of the structure. Forms shall not be removed until approval is given by ENGINEER. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement.
- B. CONTRACTOR shall remove all wood splinters on concrete surfaces after stripping of wood forms.

- END OF SECTION -

**SECTION 03 20 00**  
**CONCRETE REINFORCEMENT**

## PART 1 GENERAL

## 1.1 SUMMARY

- A. This Section covers the steel reinforcement bars, wire fabric mats, rod mats, and couplers for use in reinforced cast-in-place concrete and reinforced masonry construction.

## 1.2 RELATED WORK

- A. Related Work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 03 30 00 Cast-in-Place Concrete
  3. Section 04 22 00 Concrete Unit Masonry

### 1.3 REFERENCES

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

## 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 and Commentary
4. ACI 350R Code Requirements for Environmental Engineering Concrete Structures and Commentary

### C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |                |  |
|----------------|--|
| 1. ASTM A 184  | Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement                         |
| 2. ASTM A 615  | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.                  |
| 3. ASTM A 767  | Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement                    |
| 4. ASTM A 775  | Standard Specification for Epoxy-Coated Steel Reinforcing Bars   |
| 5. ASTM A 1064 | Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete |

#### D. CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

1. CRSI (DA4)      Manual of Standard Practice (MSP-1)

E. Wire Reinforcement Institute (WRI)

1. Manual of Standard Practice for Welded Wire Reinforcement

#### **1.4 SUBMITTALS**

- A. CONTRACTOR shall submit the following in accordance with Section 01 33 00 - Submittal Procedures:
1. Drawings of Concrete Reinforcement System with details showing reinforcing steel schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing.
  2. Reinforcing Steel with certified copies of mill reports attesting that the reinforcing steel furnished meets the requirements specified, prior to the installation of reinforcing steel.
  3. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, manufacturer's literature shall be submitted which contains instructions and recommendations for installation for each type of coupler used; certified test reports which verify the load capacity of each type and size of coupler used; and shop drawings which show the location of each coupler with details of how they are to be installed in the formwork.

#### **1.5 DELIVERY AND STORAGE**

- A. Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

### **PART 2 PRODUCTS**

#### **2.1 DOWELS**

- A. Dowels shall conform to ASTM A 615, Grade 60.

#### **2.2 FABRICATED BAR MATS**

- A. Fabricated bar mats shall conform to ASTM A 184.

#### **2.3 REINFORCING STEEL**

- A. Reinforcing steel shall be deformed bars conforming to ASTM A 615 grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 1064. When no grade is indicated use 60 ksi grade steel. Special coated bars (epoxy and zinc) may be specified for use in a highly corrosive atmosphere where concrete cover is not considered sufficient, in which case reference to ASTM A 767 and A 775 will be included.

#### **2.4 WELDED WIRE FABRIC**

- A. Welded wire fabric reinforcement shall conform to the requirements of ASTM A 1064. Welded wire fabric with longitudinal wire of W4 size and smaller shall be either furnished in flat sheets or in rolls with a core diameter of not less than 10 inches. Welded wire fabric with longitudinal wires larger than W4 size shall be furnished in flat sheets only.



## 2.5 WIRE TIES

- A. Wire ties shall be 16-gauge or heavier black annealed steel wire.

## 2.6 MECHANICAL COUPLERS

- A. Mechanical couplers shall only be provided where shown on the Contract Drawings. The couplers shall develop a tensile strength which exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
- B. Where the type of coupler used is composed of more than one component, all components required for a complete splice shall be supplied. This shall apply to all mechanical splices, including those splices intended for future connections.
- C. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.
- D. Mechanical Couplers shall be **Lenton Form Saver by Erico Products, D51A DBR by Dayton Superior**, or approved equal.

## 2.7 SUPPORTS

- A. Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI (DA4) MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall be not less than 4 inches square when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete.
- B. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 1/2-inch of concrete surface shall be plastic protected or shall be stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.
- C. Concrete blocks (dobies), used to support and position reinforcement steel, shall have the same or higher compressive strength as specified for the concrete in which it is located. Wire ties shall be embedded in concrete block bar supports.
- D. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating which extends at least 1/2-inch from the concrete surface. Plastic shall be gray in color.

## 2.8 EPOXY ANCHOR GROUT

- A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy anchor grout shall meet the requirements of Section 03 60 00 – Grout.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. All reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the requirements of the Building Code and the requirements specified herein.

### **3.2 REINFORCEMENT**

- A. Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete.
- B. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety.
- C. Placement:
  - 1. Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete.
  - 2. Reinforcement shall be placed in accordance with ACI 318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.
  - 3. All reinforcement steel shall be supported by concrete, plastic or metal supports, spacers or metal hangers which are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used, in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. All concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties which are embedded in the blocks.
  - 4. For concrete over formwork, CONTRACTOR shall furnish concrete, metal, plastic, or other acceptable bar chairs and spacers.
  - 5. Limitations on the use of bar support materials shall be as follows.
    - a. Concrete Dobies: permitted at all locations except where architectural finish is required.
    - b. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
    - c. Plastic Bar Supports: permitted at all locations except on grade.
  - 6. Tie wires shall be bent away from the forms in order to provide the specified concrete coverage.
  - 7. Bars additional to those shown which may be found necessary or desirable by CONTRACTOR for the purpose of securing reinforcement in position shall be provided by CONTRACTOR at no additional cost to OWNER.

8. Welded wire fabric placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.
9. Epoxy coated reinforcing bars shall be stored, transported, and placed in such a manner as to avoid chipping of the epoxy coating. Specially coated bar supports shall be used. CONTRACTOR shall repair all chips or cracks in the epoxy coating with a compatible epoxy repair material prior to placing concrete.
10. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

D. Splicing:

1. Splices of reinforcement shall conform to ACI 318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 6-inches. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

### **3.3 WELDED-WIRE FABRIC**

- A. Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 2 inches. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 4 feet. Fabric shall be positioned using supports.

### **3.4 DOWELS**

- A. Dowels shall be installed in slabs on grade at locations indicated and at right angles to the joint being doweled. Dowels shall be accurately aligned parallel to the finished concrete surface and rigidly supported during concrete placement. A PVC sleeve shall cover one end of dowels up to the joint location at the center of the bar. Grease to be placed at the back of the sleeve prior inserting dowel so that the grease will flow out, around, and fully encase the inserted bar. Grease the bar before insertion. Grease shall be semi-solid, inert lubricant, such as lithium grease.

### **3.5 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS**

A. Dowel Epoxy Installation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be

- no larger than 0.25 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless noted otherwise.
  3. The hole shall be drilled by methods which do not interfere with the proper bonding of epoxy.
  4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes to be drilled shall be adjusted to avoid drilling through or damaging any existing reinforcing bars.
  5. The hole shall be blown clean with clean, dry compressed air to remove all dust and loose particles.
  6. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures that excess material will be expelled from the hole during dowel placement.
  7. Dowels shall be twisted during insertion into the partially filled hole to guarantee full wetting of the bar surface with epoxy. CONTRACTOR shall insert the bar slowly enough to avoid developing air pockets.

### **3.6 CLEANING AND PROTECTION**

- A. CONTRACTOR shall protect reinforcement steel from conditions conducive to corrosion until concrete is placed.
- B. The surfaces of all reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of all dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is a delay in placing concrete, reinforcement shall be reinspected and if necessary, recleaned.

- END OF SECTION -

**SECTION 03 25 00**  
**EXPANSION JOINTS, CONSTRUCTION JOINTS AND WATERSTOPS**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This Section covers the work necessary to furnish, install and complete expansion and construction joints, including waterstops.
- B. All waterstops and sealants in contact with potable water including waterstops embedded in concrete floors and walls of potable water tanks shall be NSF 61 certified.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 03 33 00 Cast-in-Place Concrete

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN CONCRETE INSTITUTE (ACI)
  - 1. ACI 318 Building Code Requirements for Reinforced Concrete
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - 2. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
  - 3. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
  - 4. ASTM D 570 Standard Test Method for Water Absorption of Plastics
  - 5. ASTM D 624 Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
  - 6. ASTM D 638 Standard Test Method for Tensile Properties of Plastics
  - 7. ASTM D 746 Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
  - 8. ASTM D 747 Standard Test Method for Apparent Bending Modulus of Plastics by Means of a Cantilever Beam.
  - 9. ASTM D 792 Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
  - 10. ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
  - 11. ASTM D 1752 Standard Specification for Preformed Sponge Rubber and Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

12. ASTM D 2240      Standard Test Method for Rubber Property-Durometer Hardness

D. FEDERAL SPECIFICATIONS (FS)

1. FS-TT-S-00227E      Sealing Compound: Elastomeric Type, Multi-Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

E. NSF International (NSF)

1. NSF/ANSI 61      Drinking Water System Components – Health Effects

**1.4 SUBMITTALS**

- A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures:

1. Submit certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified. ENGINEER, may take samples of any materials and have them tested by an independent testing laboratory to verify their compliance with these Specifications. All such costs shall be borne by OWNER. If any materials should fail to meet these Specifications, all costs for further testing of the replacement material shall be borne by CONTRACTOR.
2. Samples of factory fabricated waterstop joints representing in all respects the material and workmanship of the material that will be furnished under this contract. Samples will be submitted and approved by ENGINEER prior to use of the factory joints in the field.
3. Manufacturer's catalog data and manufacturer's recommended instructions for splicing of waterstops.

**1.5 OBSTRUCTIONS**

- A. CONTRACTOR shall pay particular attention to removing all obstructions such as concrete, nails, etc., from joints when movements of floor or wall sections can be expected under temperature and other conditions.

**1.6 QUALITY ASSURANCE**

- A. Waterstop manufacturer shall demonstrate five years (minimum) continuous, successful experience in production of waterstops.

**1.7 DELIVERY AND STORAGE**

- A. Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

## PART 2 PRODUCTS

### 2.1 HORIZONTAL JOINT SEALANT

- A. Horizontal joints not requiring waterstops or when so indicated on the Contract Drawings, shall be sealed using **Sikaflex-2c NS**, or approved equal, and shall meet the requirements of ASTM C-920, Type M, Grade NS, Class 25 and FS-TT-S-00227E, Type II, Class A, and shall be NSF 61 certified (Sikaflex 2c NS EZ) if in contact with potable water. Color shall match color of concrete slab.

### 2.2 VERTICAL JOINT SEALANT

- A. Vertical joints not requiring waterstops or when so indicated on the Contract Drawings, shall be sealed using **Sikaflex-2c NS**, or approved equal, and shall meet the requirements of ASTM C-920, Type M, Grade NS, Class 25 and FS-TT-S-00227E, Type II, Class A, and shall be NSF 61 (Sikaflex 2c NS EZ) certified if in contact with potable water. Color shall match color of concrete walls.

### 2.3 JOINT PRIMER

- A. All joints receiving a joint sealant shall be primed using **Sikaflex Primers 429**, or approved equal.

### 2.4 EXPANSION JOINTS

- A. Expansion joints shall be composed of cellular fibers securely bonded together and uniformly saturated with asphalt. Joint shall be resilient, flexible, and non-extruding. Expansion joints shall meet the requirements of ASTM D 1751. Manufacturer shall be **Fibre Expansion Joint by W.R. Meadows, Fiberflex by JD Russel Company**, or approved equal.

### 2.5 PVC WATERSTOPS

- A. Waterstops shall be of an approved type, supplied by an approved manufacturer and shall be plastic made of virgin polyvinylchloride (PVC) compound, shall be ribbed, uniform in dimensions, dense, homogeneous, free from porosity, and as detailed on the Contract Drawings. No reclaimed PVC shall be used in the compound. Waterstop in contact with potable water shall be NSF 61 certified.

- B. The finished waterstop material shall meet the following minimum requirements:

Tensile strength	2,000 psi min.	(ASTM D 638)
Ultimate elongation	300% min.	(ASTM D 638)
Shore A hardness	75 ± 5	(ASTM D 2240)
Specific gravity	1.38 max	(ASTM D 792)
Stiffness in flexure	600 psi min.	(ASTM D 747)
Cold brittleness	No Failure at -35°F	(ASTM D 746)
Water absorption: 48 hours	0.15% max	(ASTM D 570)
Tear Resistance	290 lb./in. min.	(ASTM D 624)

C. Manufacturer, or approved equal:

1. Vinylex Waterstop & Accessories
2. Greenstreak, Inc. (Sika Corporation)
3. Durajoint Concrete Accessories

D. Factory made waterstop joints shall have a tensile strength across the joint equal to at least 600 psi. Field splices and joints shall be made in accordance with the waterstop manufacturer's instructions using a thermostatically controlled heating iron.

## 2.6 HYDROPHILIC WATERSTOP

A. Non-bentonite rubber hydrophilic waterstop shall only be used where shown on the Contract Drawings or when approved by ENGINEER. Hydrophilic waterstop in contact with potable water including in potable water tank floor slabs and walls shall be NSF 61 certified. Size shall be as indicated on the Contract Drawings.

B. The hydrophilic waterstop shall meet the following physical properties:

Physical Property	Test Method	Result
Tensile Strength (Minimum)	ASTM D412	350 psi
Elongation (minimum)	ASTM D412	600 %
Hardness	ASTM D2240	52 +/-5 Shore A
Tear Resistance	ASTM D624	50 lb/in
Specific Gravity	ASTM D792	1.35 +/-5

C. Manufacturer, or approved equal:

1. Conseal CS-231
2. Sika Hydrotite CJ-1020-2K

## PART 3 EXECUTION

### 3.1 WATERSTOPS

A. Waterstops shall be of the type indicated and shall be installed at the locations shown to form a continuous water-tight diaphragm. The waterstop shall be correctly positioned in the forms so that the center of the waterstop is centered on the joint. Waterstop shall be held in place in the forms by use of a split form or other approved method that will positively hold the waterstop in the correct position and to the correct alignment. Vibrate concrete to obtain impervious concrete in the vicinity of all joints. In horizontal joints, ensure that the areas below the water stop are completely filled with concrete.

B. Horizontal plastic waterstops shall be bent up during placing of concrete until the concrete has been brought to the level of the waterstop; additional concrete shall then be placed over the waterstop, after which the concrete shall be thoroughly vibrated. All horizontal and vertical waterstops, which are not accessible during pouring, shall be tied off in two directions every 12 inches in such a manner that bending over one way, or another is prevented. A hog-ring or nail may be driven through both ends of the waterstop to facilitate placing and tying of waterstops to reinforcing steel forms or form-ties.



- C. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. All waterstops shall be properly spliced and joints shall be checked for strength and pinholes after splicing. Splices shall be strong enough to develop a pulling force of 75 percent of the strength of the waterstop and shall be watertight. Splices in waterstop shall be made in conformance with the recommendations of the waterstop manufacturer. Continuity of cross-sectional features shall be maintained across the splice. Splices showing evidence of separation after bending shall be remade.
- D. Install hydrophilic waterstop in accordance with the manufacturer's written instructions. Adhesives used on hydrophilic waterstop shall be NSF 61 certified. Adhesives shall meet the requirements of ASTM C 920 and shall be **Manus Bond 75-AM Lot NSF61, DAP Premium Polyurethane Construction Adhesive**, or approved equal.

### 3.2 JOINTS

- A. Joints shall be installed at locations indicated and as authorized. Joints shall be constructed to produce straight joints, and shall be vertical or horizontal, except where walls intersect sloping floors.
- B. Construction Joints
  - 1. Prior to placing the abutting concrete for all construction joints, the contact surface shall be cleaned by approved means to remove all laitance and expose the aggregate. The exposed portion of the reinforcing steel shall be cleaned of all concrete. The cleaning method shall be conducted to not damage the waterstop, if waterstop is present. Where the joint is to receive a sealant, a recess 3/4-inch deep shall be formed along the joint using a dressed-and-oiled wood strip or other method approved by ENGINEER. The wood strip shall be removed after concrete has set.
- C. Expansion Joints
  - 1. Expansion joint filler shall be used where required on the Contract Drawings. The edges of the joint shall be neatly finished with an edging tool of 1/8-inch radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a recess 3/4-inch deep to be filled with sealant. The wood strip shall be removed after the concrete has set. In lieu of the wood strip a removable expansion filler cap designed and fabricated for this purpose may be used.
- D. Joint Sealant

The joint cavity shall be cleaned by sandblasting or power wire brushing and shall be blown clean of dust and sand with compressed air before the joint sealant may be applied. Joints must be frost-free, free of oils, grease, curing compound residues, and any other foreign matter that might prevent bond. A bond breaker tape shall be installed over the joint per manufacturer's instructions. After the joints have been prepared as described above, the joints shall be primed, and the sealant shall be applied in accordance with the manufacturer's recommendations.

- END OF SECTION -

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**SECTION 03 30 00**  
**CAST-IN-PLACE CONCRETE**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section covers cast-in-place concrete mix design and placement.
- B. CONTRACTOR shall provide cast-in-place concrete as indicated in the Specifications and the Contract Drawings.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 01 45 00 Quality Control and Material Testing
  - 3. Section 01 45 01 Quality Control and Material Testing (Supplement)
  - 4. Section 03 10 00 Concrete Forming and Accessories
  - 5. Section 03 20 00 Concrete Reinforcement
  - 6. Section 03 25 00 Expansion Joints, Construction Joints, and Waterstops
  - 7. Section 09 90 00 Painting and Finishes
  - 8. Section 31 23 23 Excavation and Backfill for Structures

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN CONCRETE INSTITUTE (ACI)
  - 1. ACI 117 Specifications for Tolerances for Concrete Construction and Materials and Commentary
  - 2. ACI 211.1 Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
  - 3. ACI 301 Structural Concrete for Buildings
  - 4. ACI 304 Guide for Measuring, Mixing, Transporting, and Placing Concrete
  - 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 350R Code Requirements for Environmental Engineering Concrete Structures and Commentary
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field
  - 2. ASTM C 33 Standard Specification for Concrete Aggregates
  - 3. ASTM C 39 Standard Test Method for Compressive Strength of Cylindrical

- |                 |   |
|-----------------|---|
|                 | Concrete Specimens  |
| 4. ASTM C 42    | Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete                        |
| 5. ASTM C 78    | Standard Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)             |
| 6. ASTM C 94    | Standard Specification for Ready-Mixed Concrete   |
| 7. ASTM C 109   | Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens) |
| 8. ASTM C 143   | Standard Test Method for Slump of Hydraulic-Cement Concrete   |
| 9. ASTM C 150   | Standard Specification for Portland Cement  |
| 10. ASTM C 171  | Standard Specification for Sheet Materials for Curing Concrete  |
| 11. ASTM C 172  | Standard Specification for Sampling Freshly Mixed Concrete  |
| 12. ASTM C 173  | Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method                         |
| 13. ASTM C 192  | Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory                               |
| 14. ASTM C 231  | Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method                           |
| 15. ASTM C 260  | Standard Specification for Air-Entraining Admixtures for Concrete   |
| 16. ASTM C 309  | Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete                                |
| 17. ASTM C 494  | Standard Specification for Chemical Admixtures for Concrete   |
| 18. ASTM C 595  | Standard Specification for Blended Hydraulic Cements  |
| 19. ASTM C 618  | Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete                     |
| 20. ASTM C 1157 | Standard Performance Specification for Hydraulic Cement   |

D. NSF INTERNATIONAL (NSF)

1. NSF/ANSI 61      Drinking Water System Components - Health Effects.

## 1.4 DEFINITIONS

- A. Average Strength ( $f_{cr}$ ): The required average strength for 30 consecutive strength tests which statistically assures not more than the permissible proportions of tests will fall below Specified Strength.
- B. Specified Strength ( $f'_c$ ): The indicated strength.

## 1.5 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 – Submittal Procedures.
- B. Provide catalog information for all products to be used as part of the submitted mix design.
- C. The results of trial mix designs along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface

dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory. Indicate whether mixes have been designed for pumping. Include in the report the following information:

1. Water-cement ratio.
2. Air entrainment.
3. Proportion of materials in the mix.
4. Source and type of cement.
5. Analysis of water to be used unless potable.
6. Type and name of admixtures applied. Indicate when accelerating or retarding admixtures are to be used and the resulting change in placement times and strengths.
7. Slump, air content and temperature of samples.
8. Unit weight of fresh and dry light weight concrete.
9. Strength test data showing mix meets indicated strength requirements per ACI-301.

D. Preapproved Mix Design Data: If supplier has on record, an OWNER approved mix design, submit name and address of supplier for each mix design 1 day prior to using concrete mix.

E. Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials. Test reports shall meet the following requirements:

1. Date of mix design: No older than 365 days from the date of submission.
2. Physical properties of the aggregate: Test results shall not be older than 455 days from the date of submission. A new report will be required if the aggregate source is changed.

F. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.

G. Submit catalog information on the curing compound and the proposed location(s) to be used.

## **1.6 QUALITY ASSURANCE**

- A. Do not change material sources, type of cement, air-entraining agent, water reducing agent, other admixtures, or aggregate without ENGINEER'S approval.
- B. In proportioning materials for mixing, use scales certified by the State of Utah. Do not use volume measurement except for water and liquid admixtures.
- C. Do not change the quantity of cement per cubic yard for approved mix design without written approval of ENGINEER.

- D. Use of admixtures will not relax hot or cold weather placement requirements.
- E. Ready-mixed concrete to be in accordance with Alternate No. 3 of ASTM C-94 and the requirements in this Section.
- F. Tolerances for concrete construction and materials shall be in accordance with ACI 117.

## **1.7 PRODUCT STORAGE AND HANDLING**

- A. Store bagged and bulk cement in weatherproof enclosures to exclude moisture and contaminants.
- B. Stockpile aggregate to avoid segregation and prevent contamination.
- C. Avoid contamination, evaporation, or damage to admixtures. Protect liquid admixtures from freezing.

## **PART 2 PRODUCTS**

### **2.1 ADMIXTURES**

- A. Admixtures shall be approved by ENGINEER prior to use. Any admixtures to be used shall be included in proposed concrete mix designs.
- B. Air Entrainment: ASTM C 260.
- C. Later Reducing and Set Retarding Agents: ASTM C494.
  - 1. Type A: Set water reducing.
  - 2. Type B: Set retarding.
  - 3. Type C: Set accelerating.
  - 4. Type D: Water reducing and set retarding.
  - 5. Type E: Water reducing and set accelerating.
  - 6. Type F: High range water reducing (super plasticizer).\*
  - 7. Type G: High range water reducing and set retarding.\*
- \* The relative durability factor of water reducing admixtures shall not be less than 80 and the chlorides content (as Cl-) expressed as a percent of the cement shall not exceed 0.1 percent by weight.
- D. Calcium Chloride: None allowed.
- E. Pozzolan: Pozzolan conforming to the requirements of ASTM C 618, Class F, is allowed as a Portland cement replacing agent under the following conditions:
  - 1. The maximum percentage of Portland cement replacement is:
    - a. 15 percent, for concrete exposed to weather.
    - b. 20 percent, for interior concrete.
  - 2. Pozzolan should not exceed 25% by weight of the cement plus pozzolans.
  - 3. The minimum cement content shall be used in the design formulas before replacement is made.
  - 4. Loss of ignition of pozzolan is less than 3 percent and the water requirement does

- not exceed 100 percent.
  - 5. All other requirements of this section still apply.
  - 6. Mix designs including trial batches are required for each aggregate source and for each concrete class.
- F. Cementitious Materials showing Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished, for cement and pozzolan.

## 2.2 CEMENTITIOUS MATERIALS

- A. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall each be of one type and from one source when used in concrete which will have surfaces exposed in the finished structure. Cementitious materials shall conform to one of the following:
1. Cement: Use Portland cement, ASTM C 150, Type II, Type IIA, or Type V, low alkali, or ASTM C 595 and ASTM C 1157 IL(10)-A-MS, unless noted otherwise.
  2. Portland - Pozzolan Cement: ASTM C 595, Type IP(20 Max)-A-MS. Do not use Pozzolan cement unless approved by ENGINEER.
- B. Only one brand of cement from one manufacturing plant may be used.

## 2.3 AGGREGATES

- A. Aggregates shall be natural aggregates, free from deleterious coatings, and shall conform to the requirements of ASTM C 33, except as modified herein. Aggregates shall not be potentially reactive as defined in Appendix XI of ASTM C 33. CONTRACTOR shall import nonreactive aggregates if local aggregates are reactive.
- B. Fine Aggregates
1. Fine aggregate shall consist of clean, sharp, natural sand and shall conform to the requirements of ASTM C 33. Fine aggregate shall be graded as follows:

FINE AGGREGATES	
Sieve Size	Percent Passing by Weight
3/8 inch	100
#4	95-100
#8	80-100
#16	50-85
#30	25-60
#50	10-30
#100	2-10

2. Fine aggregates shall have no more than two percent by weight passing #200 sieve.
- C. Coarse Aggregate
1. Coarse aggregate shall be washed gravel or crushed stone, or a combination of

these materials, consisting of hard, tough, durable particles free from adherent coatings. It shall contain no more than 15 percent flat or elongated particles. A thin, flat or elongated particle is defined as a particle having a maximum dimension in excess of five times its minimum dimension. Aggregate which has disintegrated or weathered badly under exposure conditions similar to those which will be encountered in the work under consideration shall not be used. Coarse aggregate shall be graded as follows (ASTM C 33):

COARSE AGGREGATES	
Sieve Size	Percent Passing by Weight
1-1/2 inch	100
1 inch	95-100
1/2 inch	25-60
#4	0-10
#8	0-5

2. Coarse aggregates shall have no more than 1.75 percent by weight passing #200 sieve. Proof of gradation will be provided to ENGINEER by CONTRACTOR.

## 2.4 ACI MIX DESIGN

- A. The amount by which the average strength ( $f_{cr}$ ) of a concrete mix exceeds the specified compressive strength ( $f'_c$ ) shall be based upon no more than 1 in 100 random individual strength tests falling more than 500 psi below the specific strength.
- B. Proportion the materials in accordance with ACI 211.1, 211.2 or 211.3 as applicable to produce concrete having the properties or limitations of Table No. 03 30 00-A.

## 2.5 HAND MIXING

- A. Do not hand mix batches exceeding 0.5 cubic yards.
- B. Hand mix only on watertight platform. Mix cement and aggregate prior to adding water.
- C. Ensure all stones are thoroughly covered with mortar and mixture is of uniform color and consistency.

## 2.6 HEATING, WATER AND AGGREGATE

- A. Do not allow products of fuel combustion to contact the aggregate.
- B. Heat mixing water to maximum temperature of 150 degrees F. Heat aggregates uniformly.
- C. Do not mix cement with water and aggregate at a mix temperature greater than 100 degrees F.

## 2.7 WATER

- A. Water shall be potable, except that non-potable water may be used if it produces cylinders having 7- and 28-day strengths at least 90 percent of the strength of similar



specimens made with water from a municipal supply. The strength comparison shall be made on cylinders, identical except for mixing water, prepared and tested in accordance with ASTM C 109. Water for curing shall not contain any substance injurious to concrete, or which causes staining.

## **2.8 PROPORTIONS OF MIX**

- A. Mixture Proportioning, Normal Weight Concrete: All concrete that must be watertight and resistant to freeze-thaw cycles and to naturally occurring or commonly used chemicals should be air entrained. All materials should be proportioned to produce a well-graded mixture of high density and maximum workability with a minimum specified 28-day compressive strength of concrete classification. Trial batches shall contain materials proposed to be used in the project. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios. Trial mixes shall be proportioned to produce concrete strengths specified. In the case where ground iron blast-furnace slag is used, the weight of the slag will be substituted in the equations for the term P which is used to denote the weight of pozzolan. Trial mixtures shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results a curve shall be plotted showing the relationship between water-cement ratio and strength. Maximum water-cement or water-cement plus pozzolan Ratio: 0.45.
- B. Average Strength: In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1,000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

TABLE NO. 03 30 00-A

CONCRETE MIX PROPERTIES (e)					
CONCRETE PROPERTIES	CONCRETE CLASSIFICATION(S)				
	Class 5000	Class 4500	Class 4000	Class 3500	Class 3000
Specified Compressive Strength $f_c'$ at 28 days, min., psi	5,000	4,500	4,000	3,500 (d)	3,000 (d)
Compressive Strength at 7 days, min., psi (a)	3,350	3,015	2,680	2,345	2,010
Cement content (94 lb. sacks of cement per cubic yard of concrete), min. (b)	7.5	7.0	6.5	6.0	5.5
Entrained air content, (% by volume).	6±1	6±1	6±1	6±1	6±1
Slump Range, in. (c)	1 - 4 (f)	1 - 4 (f)	1 - 4 (f)	2 - 4	2 - 4
Maximum Water Cement Ratio	0.45	0.45	0.45	0.45	0.45

(a) Used for monitoring purposes only.

(b) May include pozzolan replacements if approved by ENGINEER.

(c) Not more than 8 inches after adding high range water reducing admixture at site.

(d) Not allowed if concrete is exposed to freezing and thawing temperatures. Use Class 4000 or higher compressive strength and 6±1.0 percent air entrainment.

(e) All mix designs must be approved by ENGINEER.

(f) 1-3" for footings, sub-structural walls and 1-4" for slabs, beams, reinforced walls and columns.

## 2.9 CURING MATERIALS

### A. Normal Curing Compound

1. The curing compound shall be white pigmented and shall conform to ASTM C 309, Type 2 Class B.
2. Sodium silicate compounds cannot be used.
3. Manufacturer, or approved equal:
  - a. 1200-White by W.R. Meadows
  - b. White Resin Cure J10W by Dayton Superior
  - c. Safe-Cure 2000 by ChemMasters
  - d. Aqua Kure White by Lambert Corporation

### B. Dissipating Curing Compound

1. When the curing compound must be removed for finishes or grouting, compounds shall be of a dissipating type, conforming to the requirements of ASTM C 309, Type

- 1 or Type 2, Class B
- 2. Manufacturer, or approved equal:
  - a. 1100-Clear by W.R. Meadows
  - b. Kurez DR VOX by Euclid Chemical Company
  - c. Clear Cure VOC J7WB by Dayton Superior
  - d. Safe-Cure Clear DR by ChemMasters

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. CONTRACTOR shall inform ENGINEER at least 72 hours in advance of time and places at which CONTRACTOR intends to place concrete. All preparation work for concrete placements shall be substantially completed at least 2 workdays prior to the scheduled start of concrete placement to allow for ENGINEER's review and any necessary corrections.
- B. Provide concrete with the minimum compressive strengths at 28 days per Table 03 30 00-2.

**TABLE NO. 03 30 00-2**

TYPE OF WORK	MIN 28-DAY COMPRESSIVE STRENGTH (PSI)
Buried Vaults	4,500
Water Containing Structures	5,000
Footings and Foundations	3,500
Structure Slab on Grade	4,000
Sidewalks, Curbs, and Gutters	3,000
Thrust Blocks	3,000

### **3.2 PREPARATION OF SURFACES**

- A. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Conduit and other similar items shall be in place and clean of any deleterious substance.
- B. Foundations: Earthwork shall be as specified. Flowing water shall be diverted without washing over freshly deposited concrete. Rock foundations shall be cleaned by high velocity air-water jets, sandblasting, or other approved methods. Debris and loose, semi-detached or unsound fragments shall be removed. Rock surfaces shall be moist but without free water when concrete is placed. Semi porous subgrades for foundations and footings shall be damp when concrete is placed. Pervious subgrades shall be sealed by blending impervious material with the top 6 inches of the in-place pervious material or by covering with an impervious membrane.
- C. Preparation of Previously Placed Concrete: Concrete surfaces to which other concrete

is to be bonded shall be roughened in an approved manner that will expose sound aggregate uniformly without damaging the concrete. Laitance and loose particles shall be removed. Surfaces shall be moist but without free water when concrete is placed.

### **3.3 INSTALLATION OF EMBEDDED ITEMS**

- A. Embedded items shall be free from oil, loose scale or rust, and paint. Embedded items shall be installed at the locations indicated and required to serve the intended purpose. Voids in sleeves, slots and inserts shall be filled with readily removable material to prevent the entry of concrete.
- B. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations as indicated or shown on the Contract Drawings. Proper placement and locations shall be the responsibility of CONTRACTOR.

### **3.4 BATCHING, MIXING AND TRANSPORTING CONCRETE**

- A. Ready-mixed concrete shall be batched, mixed, and transported in accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and non-agitating units shall comply with NRMCA TMMB-1. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA-QC 3.
- B. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quantity and quality of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by ENGINEER.
- C. Truck mixers and their operation must be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than 1 inch when the specified slump is 3 inches or less, or more than 2 inches when the specified slump is more than 3 inches, the mixer shall not be used on the work unless the causing condition is corrected and satisfactory performance is verified by additional slump tests. All mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- D. Admixtures: Admixtures shall be batched within an accuracy of 3 percent. Where two or more admixtures are used in the same batch, they shall be batched separately and must be compatible. Retarding admixture shall be added within one minute after addition of water is complete or in the first quarter of the required mixing time, whichever is first. Superplasticizing admixtures shall be added at the project site, and the concrete with the admixture shall be mixed 4 to 5 minutes before placing as recommended by manufacturer. Concrete that shows evidence of total collapse or segregation caused by the use of admixture shall be removed from the site.
- E. Control of Mixing Water: No water from the truck system or elsewhere shall be added after the initial introduction of mixing water for the batch. No water shall be added at the

jobsite without the approval of ENGINEER.

### **3.5 SAMPLING AND TESTING**

- A. Sampling and Testing of the concrete will be as defined in Section 01 45 00 – Quality Control and Material Testing. If there are discrepancies between this Section and Section 01 45 00, the more stringent requirement shall apply.
1. Aggregates: Aggregates for normal weight concrete shall be sampled and tested in accordance with ASTM C 33.
  2. Sampling of Concrete: Samples of concrete for air, slump, unit weight, and strength tests shall be taken in accordance with ASTM C 172.
    - a. Air Content: Test for air content shall be performed in accordance with ASTM C 173 or ASTM C 231. A minimum of 1 test shall be conducted each time a slump test is made.
    - b. Slump: At least 1 slump test shall be made on randomly selected batches of each mixture of concrete for every 100 cubic yards of ready-mixed concrete delivered to the job site. Also note the time batched at the plant and the starting time when unloading began at the site. Tests shall be performed in accordance with ASTM C 143.
    - c. Temperature: Concrete and air temperatures shall be measured and recorded with each slump test or with each set of cylinders and the air temperature shall also be recorded when the air temperature at the site is 40 degrees F or below and/or 90 degrees F or above.
  3. Evaluation and Acceptance of Concrete
    - a. Frequency of Testing: Samples for strength tests of each class of concrete placed each day shall be taken not less than once a day, nor less than once for each 100 cubic yards of concrete, nor less than once for each 3,000 square feet of surface area for slabs or walls. If this sampling frequency results in less than 5 strength tests for a given class of concrete, tests shall be made from at least 5 randomly selected trucks or from each truck if fewer than 5 truck loads are used. Field cured specimens for determining form removal time or when a structure may be put in service shall be made in numbers directed to check the adequacy of curing and protection of concrete in the structure. The specimens shall be removed from the molds at the age of 24 hours and shall be cured and protected, insofar as practicable, in the same manner as that given to the portion of the structure the samples represent. Each sample used to mold strength test specimens shall be tested for slump, air content, and temperature.
    - b. Testing Procedures: Cylinders for acceptance tests shall be molded and cured in accordance with ASTM C 31. Cylinders shall be tested in accordance with ASTM C 39. A strength test shall be the average of the strengths of two (2) 6-inch diameter by 12-inch high cylinders made from the same sample of concrete and tested at 28 days or at another specified test age. If 4-inch diameter cylinders are used, the strength shall be the average of the strengths of three (3) 4-inch by 8-inch high cylinders.
    - c. Evaluation of Results: Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength and no individual strength test result falls below the required strength by more than 500 pounds per square inch.

- d. Unless noted otherwise, make a minimum of five (5) 6-inch diameter by 12-inch high concrete cylinders or six (6) 4-inch diameter by 8-inch high cylinders each time a test is required. When concrete is being placed in suspended slabs, beams and retaining walls make two (2) extra cylinders which must be cured on site. The extra cylinders will be used to determine when to remove forms and/or when to backfill.
- B. Investigation of Low-Strength Test Results: When any strength test of standard-cured test cylinder falls below the specified strength requirement by more than 500 pounds per square inch, or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that load-carrying capacity of the structure is not jeopardized. Nondestructive testing in accordance with ASTM C 597, ASTM C 803 or ASTM C 805 may be permitted by ENGINEER to determine the relative strengths at various locations in the structure as an aid in evaluating concrete strength in place or for selecting areas to be cored. Such tests, unless properly calibrated and correlated with other test data, shall not be used as a basis for acceptance or rejection. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in a place that is considered potentially deficient. The location of cores shall be determined by ENGINEER to least impair the strength of the structure. If the concrete in the structure will be dry under service conditions, the cores shall be air dried (temperature 60 to 80 degrees F, relative humidity less than 60 percent) for seven days before testing and shall be tested dry. If the concrete in the structure will be more than superficially wet under service conditions, the cores shall be tested after moisture conditioning in accordance with ASTM C 42. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to or at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. If the core tests are inconclusive or impractical to obtain, or if structural analysis does not confirm the safety of the structure, load tests may be directed by ENGINEER in accordance with the requirements of ACI 318. Concrete work evaluated by structural analysis or by results of a load test and found deficient shall be corrected in a manner satisfactory to ENGINEER. All investigations, testing, load tests, and correction of deficiencies shall be performed, and approved by ENGINEER, at the expense of CONTRACTOR.

### **3.6 CONVEYING CONCRETE**

- A. Concrete shall be conveyed from mixer to forms as rapidly as possible and within the time interval specified in paragraph 3.7 CONCRETE PLACEMENT by methods which will prevent segregation or loss of ingredients. Conveying concrete shall be in accordance with the requirements of ACI 304.
  - 1. Chutes: When concrete can be placed directly from a truck mixer or other transporting equipment, chutes attached to this equipment may be used. Separate chutes will not be permitted except when specifically approved.
    - a. Use metal or metal lined chutes with a maximum length of 20-feet.
    - b. The minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them.
  - 2. Buckets: Bucket design shall be such that concrete of the required slump can be

readily discharged. Bucket gates shall be essentially grout tight when closed. The bucket shall provide means for positive regulations of the amount and rate of deposit of concrete in each dumping position.

3. Pumps: Concrete may be conveyed by positive displacement pumps when approved. Pump shall be the piston or squeeze pressure type. Pipeline shall be steel pipe or heavy-duty flexible hose. Inside diameter of the pipe shall be at least three times the maximum size of the coarse aggregate. Distance to be pumped shall not exceed the limits recommended by the pump manufacturer. Concrete shall be supplied to the pump continuously. When pumping is completed, the concrete remaining in the pipeline shall be ejected without contaminating the concrete in place. After each use, the equipment shall be thoroughly cleaned. Flushing water shall be wasted outside the forms.

### **3.7 CONCRETE PLACEMENT**

- A. Mixed concrete which is transported in truck mixers or agitators or concrete which is truck mixed, shall be discharged within 1-1/2 hours or before the drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates or the introduction of the cement to the aggregates. These limitations may be waived by ENGINEER if the concrete is of such slump after the 1-1/2 hour time or 300 revolution limit has been reached that it can be placed, without the addition of water to the batch. When the concrete temperature exceeds 85 degrees F, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the truck.
1. Placing Operation: Concrete shall be handled from mixer to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by CONTRACTOR prevent proper consolidation, finishing and curing. Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 4 feet except where suitable equipment is provided to prevent segregation and where specifically authorized. Concrete should not be allowed to drop through a cage of reinforcing steel. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 12 inches thick, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screened to the proper level to avoid excessive shimming or grouting.
  - a. Additional requirements for depositing concrete in walls include, but are not limited to:
    - 1) Deposit concrete in a continuous operation until section is completed.
    - 2) Place concrete in approximately horizontal layers 2 ft maximum thickness.
    - 3) Each layer of concrete shall be plastic when covered with the following layer.
    - 4) Rate of vertical rise not more than 4 ft per hour.
    - 5) Pump concrete or use a tremie having varying lengths for placing concrete in columns and walls to prevent free fall of more than 4 ft.

- 6) Allow concrete to thoroughly settle before top is finished. Remove all laitance, debris, and surplus water from surfaces at tops of forms by screeding, scraping, or other effective means.
- b. Additional requirements for depositing concrete in slabs include, but are not limited to:
  - 1) Deposit concrete in a continuous operation until section is completed.
  - 2) Concrete shall be deposited as nearly as practicable to its final position to avoid segregation due to rehandling or flowing.
  - 3) In sloping slabs, proceed uniformly from the bottom of the slab to the top for the full width of the placement.
2. Consolidation: Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 4 inches or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 8,000 vibrations per minute, and the head diameter and amplitude shall be appropriate for the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a few inches. The vibrator shall penetrate rapidly to the bottom of the layer and at least 6 inches into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then withdrawn slowly. The use of form vibrators must be specifically approved. Vibrators shall not be used to transport concrete within the forms. Slabs 4 inches and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique.
- B. Cold Weather Requirements: Cold weather requirements shall conform to ACI 306 and this Specification. Special protection measures, approved by ENGINEER, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. Provisions should be made to keep the concrete at a minimum temperature of 50 degrees F for 7 days. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 32 degrees F. No concrete shall be placed on frozen ground. The temperature of the concrete when placed shall be not less than 55 degrees F nor more than 75 degrees F. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals, or other materials shall not be incorporated in the concrete to prevent freezing. Calcium chloride shall not be used.
- C. Hot Weather Requirements: Hot weather requirements shall conform to ACI 305 and this Specification. The temperature of the concrete placed during hot weather shall not exceed 85 degrees F except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. In no case shall the placing temperature exceed 95 degrees F.

### **3.8 CONSTRUCTION JOINTS**

- A. Construction joints shall be located as indicated on the Contract Drawings. Where concrete work is interrupted by weather, end of work shift or other similar type of delay,



location and type of construction joint shall be subject to approval of ENGINEER. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete is no longer plastic, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints are required, a strip of 1-inch square-edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 1 inch above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph 3.2, PREPARATION OF SURFACES.

### **3.9 FINISHING CONCRETE**

#### **A. Formed Surfaces**

1. **Repair of Surface Defects:** Surface defects shall be repaired within 24 hours after the removal of forms. Honeycombed and other defective areas shall be cut back to solid concrete or to a depth of not less than 1 inch, whichever is greater. Edges shall be cut perpendicular to the surface of the concrete. The prepared areas shall be dampened and brush-coated with neat cement grout. The repair shall be made using mortar consisting of not more than 1 part cement to 2-1/2 parts sand. The mixed mortar shall be allowed to stand to stiffen (approximately 45 minutes), during which time the mortar shall be intermittently remixed without the addition of water. After the mortar has attained the stiffest consistency that will permit placing, the patching mix shall be thoroughly tamped into place by means approved by ENGINEER and finished slightly higher than the surrounding surface. For Class A and Class B finished surfaces the cement used in the patching mortar shall be a blend of job cement and white cement proportioned to produce a finished repair surface matching, after curing, the color of adjacent surfaces. Holes left after the removal of form ties shall be cleaned and filled with patching mortar. Holes left by the removal of tie rods shall be reamed and filled by dry packing. Repaired surfaces shall be cured as required for adjacent surfaces. The temperature of concrete, mortar patching material, and ambient air shall be above 50 degrees F while making repairs and during the curing period. Concrete with defects which affect the strength of the member or with excessive honeycombs will be rejected, or the defects shall be corrected as directed by ENGINEER.
2. **Class A Finish:** Where a Class A finish is indicated, fins shall be removed. A mortar mix consisting of one-part Portland cement and two parts well-graded sand passing a No. 30 sieve, with water added to give the consistency of thick paint, shall be prepared. White cement shall be used to replace part of the job cement. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood-floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads until all visible grout film is removed.

The rubbing pads shall have on their surfaces the same sand-cement mix specified above but without any mixing water. The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours. The temperature of the air adjacent to the surface shall be not less than 50 degrees F for 24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas.

3. Class B Finish: Where a Class B finish is indicated, fins shall be removed. Concrete surface shall be smooth with a texture at least equal to that obtained using Grade B-B plywood forms.
  4. Class C Finish: Where a Class C finish is indicated, fins shall be removed. Concrete surfaces shall be relatively smooth with a texture imparted by the forms used.
  5. Class D Finish: Where a Class D finish is indicated, fins exceeding 1/4 inch in height shall be chipped or rubbed off. Concrete surfaces shall be left with the texture imparted by the forms used.
  6. See Specification Section 09 90 00 Painting and Finishes for required finishes.
- B. Unformed Surfaces: In cold weather, the air temperature in areas where concrete is being finished shall not be less than 50 degrees F in accordance with ACI 306R. In hot windy weather when the rate of evaporation of surface moisture, as determined by methodology presented in ACI 305R, may reasonably be expected to exceed 0.2 pounds per square foot per hour; coverings, windbreaks, or fog sprays shall be provided as necessary to prevent premature setting and drying of the surface. The dusting of surfaces with dry materials or the addition of water during finishing will not be permitted. Finished surfaces shall be plane, with no deviation greater than 5/16-inch when tested with a 10-foot straightedge. Surfaces shall be pitched to drains.
1. Rough-Slab Finish: Slabs to receive fill or mortar setting beds shall be screened with straightedges immediately after consolidation to bring the surface to the required finish level with no coarse aggregate visible.
  2. Float Finish: Slabs to receive a steel trowel finish and slabs where indicated shall be given a float finish. Screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. After the concrete has stiffened to permit the operation and the water sheen has disappeared, it shall be wood floated. Concrete that portrays stickiness shall be finished with a magnesium float in lieu of a wood float and left free of ridges and other projections. Float finish is normally specified for surfaces that will receive other treatment such as built-up roofing, nonslip surfacing material. Float Finish shall not be used on wearing surfaces.
  3. Trowel Finish: Slabs where indicated, shall be given a trowel finish immediately following floating. Surfaces shall be trowelled to produce smooth, dense slabs free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. A final hard steel troweling shall be done by hand. Trowel finish shall be used on wearing surfaces and where a smooth finish is required.
  4. Broom Finish: After floating, slabs where indicated, shall be lightly troweled, and then broomed with a fiber-bristle brush in a direction transverse to that of the main traffic.
  5. See Specification Section 09 90 00 Painting and Finishes for required finishes.

### 3.10 CURING AND PROTECTION

- A. General: All concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
Concrete with Type II or IIA, or V, low alkali cement	7 days
Concrete with Type IP-A(MS) cement blended with pozzolan	10 days

- B. Immediately after placement, concrete shall be protected from premature drying extremes in temperatures, rapid temperature change, mechanical injury and injury from rain and flowing water. Air and forms in contact with concrete shall be maintained at a temperature above 50 degrees F for the first 3 days and at a temperature above 32 degrees F for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. All materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat shall be permitted near or in direct contact with the concrete at any time. Curing shall be accomplished by any of the following methods, or combination thereof, as approved.
- C. Moist Curing: Concrete to be moist cured shall be maintained continuously wet for the entire curing period. If water or curing materials used stains or discolors concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned. When wooden forms are left in place during curing, they shall be kept wet at all times. If the forms are removed before the end of the curing period, curing shall be carried out on unformed surfaces, using suitable materials. Horizontal surfaces shall be cured by ponding, by covering with a 2-inch minimum thickness of continuously saturated sand, or by covering with waterproof paper, polyethylene sheet, polyethylene-coated burlap, or saturated burlap. Once the moist curing has started the concrete surface must not be allowed to become surface dry for the entire curing period.
- D. Membrane Curing:
1. Normal membrane curing compound shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete. Use a Dissipating curing compound for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring.
  2. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam.
  3. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface.
  4. Surfaces shall be thoroughly moistened with water and the curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to

- prevent moisture loss during the curing period.
5. Compound shall be applied in a one-coat continuous operation by mechanical spraying equipment, at a uniform coverage in accordance with the manufacturer's printed instructions.
  6. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified.
  7. On surfaces permanently exposed to view, the surface shall be shaded from direct rays of the sun for the duration of the curing period.
  8. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

### **3.11 QUALITY CONTROL TESTING**

- A. Quality Control Testing shall be in accordance with Section 01 45 00 – Quality Control and Material Testing.

- END OF SECTION -

**SECTION 03 31 05**  
**CONTROLLED LOW STRENGTH MATERIAL**

**PART 1 GENERAL**

**1.1 REQUIREMENTS**

- A. CONTRACTOR shall provide Controlled Low Strength Material (CLSM), complete and in place, in accordance with the Contract Documents.
- B. CLSM shall be placed where indicated and may be used, if ENGINEER approves, for the following purposes:
  - 1. Normal CLSM with high slump, non-segregating consistency that readily flows and fills voids and difficult to reach places: pipe zone fill, trench zone fill, pipe abandonment, structure backfill, and structure cavity fill.
  - 2. Foundation CLSM is used where higher early strengths are required and future excavation is not likely to be required.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 31 23 15 Excavation and Backfill for Buried Pipelines

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM C 33 Standard Specification for Concrete Aggregates
  - 2. ASTM C 94 Standard Specification for Ready-Mixed Concrete
  - 3. ASTM C 138 Standard Test Method for Density (Unit Weight), Yield and Air Content (Gravimetric) of Concrete
  - 4. ASTM C 150 Standard Specification for Portland Cement
  - 5. ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete.
  - 6. ASTM C 403 Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
  - 7. ASTM C 494 Standard Specification for Chemical Admixtures for Concrete
  - 8. ASTM C 595 Standard Specification for Blended Hydraulic Cements
  - 9. ASTM C 618 Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
  - 10. ASTM C 803 Standard Test Method for Penetration Resistance of Hardened Concrete
  - 11. ASTM C 1157 Standard Performance Specification for Hydraulic Cement
  - 12. ASTM D 4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
  - 13. ASTM D 4832 Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

## **1.4 SUBMITTALS**

- A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop Drawings:
  - 1. CLSM mix designs which show the proportions and gradations of all materials proposed for each type of CLSM indicated. Each mix design shall be accompanied by independent laboratory test results of the indicated properties.
  - 2. If Contractor proposes to provide lower strength CLSM with aggregates that do not conform to ASTM C 33, Shop Drawings shall include a testing program that will be used to control the variability of the aggregates. The testing program shall be acceptable to ENGINEER.

## **1.5 QUALITY ASSURANCE:**

- A. All testing will be done by a testing laboratory at CONTRACTOR'S expense, except as otherwise indicated.
- B. If tests of the CLSM show non-compliance with the specifications, CONTRACTOR shall make changes as may be required to achieve compliance. Performing and paying for subsequent testing to show compliance shall be CONTRACTOR's responsibility.
- C. Correlation Tests
  - 1. CONTRACTOR shall perform a field correlation test for each mix of CLSM used in pipe zone, trench zone, or backfill used in amounts greater than 100 cubic yards or when CLSM is required to support traffic or other live loads on the fill less than 7 days.
  - 2. Field correlation tests shall be performed in a test pit similar in cross section to the WORK and at least 10-feet long at a location near the WORK. The proposed location shall be acceptable to ENGINEER.
  - 3. Laboratory and field tests shall be performed on samples taken from the same CLSM batch mix. All tests shall be performed by a laboratory at CONTRACTOR's expense.
  - 4. Testing shall be performed once each 2-hours during the first 8 hours, once each 8-hours during the first week, and once each 24-hours until the CLSM mix reaches the maximum design strength.
    - a. Compression testing shall be in accordance with ASTM D 4832.
    - b. Setting test shall be in accordance with ASTM C 403.
    - c. Density tests shall be in accordance with ASTM C 138.

## **PART 2 PRODUCTS**

### **2.1 CONTROLLED LOW STRENGTH MATERIAL**

- A. CLSM shall be a mixture of cement, pozzolan, coarse and fine aggregate, admixtures, and water, mixed in accordance with ASTM C 94.
- B. Composition: The following parameters shall be within the indicated limits and as necessary to produce the indicated compressive strengths.

1. The actual mix proportions and flow characteristics shall be determined by the producer of the CLSM to meet requirements for compressive strength as specified for Normal CLSM or Foundation CLSM.
2. Entrained air content shall be between 15 percent minimum and 30 percent maximum.
3. Water reducing agent content as necessary.

**C. Properties**

1. Density shall be between 120 PCF minimum and 145 PCF maximum.
2. Slump shall be as required by CONTRACTOR methods, but shall not promote segregation, nor shall slump exceed 10 inches.
3. Compressive strength at 28 days:
  - a. Normal CLSM: Between 100 psi minimum and 300 psi maximum. Unless specifically indicated otherwise, all CLSM shall be Normal CLSM.
  - b. Foundation CLSM: 500 psi to 1,000 psi.

**2.2 CEMENT**

- A. Cement shall be Type II in accordance with ASTM C 150 or Type IP(10)-MS or Type IL(10)-MS per ASTM C 595 and ASTM C 1157.

**2.3 POZZOLAN**

- A. Pozzolan shall be Type F or C in accordance with ASTM C 618. Pozzolan content, by weight, in Normal CLSM, shall not be greater than 90 percent.

**2.4 AGGREGATE**

- A. Aggregate shall consist of a well graded mixture of crushed rock, soil, or sand, with a nominal maximum size of 3/8-inch. One hundred percent shall pass the 1 inch sieve; no more than 30 percent shall be retained on the 3/8-inch sieve; and no more than 12 percent shall pass the number 200 sieve. If more than 5 percent of the aggregate passes the number 200 sieve, the material passing the number 200 sieve shall have a plasticity index of less than 0.73(liquid limit-20), when tested in accordance with ASTM D 4318. All aggregate shall be free from organic matter and shall not contain more alkali, sulfates, or salts than the native materials at the Site.

**2.5 ADMIXTURES**

- A. Air entraining admixtures shall be in accordance with ASTM C 260.
- B. Water reducing admixtures shall be in accordance with ASTM C 494.

**2.6 WATER**

- A. Water shall be potable, clean, and free from objectionable quantities of silt, organic matter, alkali, salt, and other impurities.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Subgrade and compacted fill to receive CLSM shall be prepared according to Section 31 23 15 Excavation and Backfill for Buried Pipelines.

### **3.2 BATCHING, MIXING AND DELIVERY**

- A. Batching, mixing, and delivery of CLSM shall conform to ASTM C 94. CLSM shall be mixed at a batch plant acceptable to the ENGINEER and shall be delivered in standard transit mix trucks.

### **3.3 PLACEMENT**

- A. CLSM shall be placed by tailgate discharge, conveyor belts, pumped, or other means acceptable to the ENGINEER. CLSM shall be directed in place by vibrator, shovel, or rod to fill all crevices and pockets. Avoid over-consolidation which causes separation of aggregate sizes.
- B. CLSM shall be continuously placed against fresh material unless otherwise approved by ENGINEER. When new material is placed against existing CLSM, the placement area shall be free from all loose and foreign material. The surface of the existing material shall be soaked a minimum of one hour before placement of fresh material but no standing water shall be allowed when placement begins.
- C. CLSM placement for piping. Pipe shall be placed on soil pads and bedding placed under the pipe from one side and vibrated, as necessary, so that the CLSM flows to the opposite side. CLSM shall then be added to both sides of the pipe and vibrated until it fills the space between the pipe and the excavated trench bottom. CLSM shall be deposited in such a manner as to avoid uplift and deposited in its final position to avoid disturbing the pipe trench causing foreign material to mix with the cement slurry.
- D. Pipe zone backfill shall not be placed or compacted until the CLSM has reached initial set. Pipes placed on steep slopes may require a stiffer mix to prevent CLSM from flowing down the trench. Vibration may be required to ensure that the CLSM fills all voids.
- E. Temperature of the CLSM shall be between 50 and 90 degrees F, when placed. CLSM shall not be placed when the air temperature is below 40 degrees F. No CLSM shall be placed against frozen subgrade or other materials having temperature less than 32 degrees F.

### **3.4 FINISHING**

- A. The finish surface shall be smooth and to the grade indicated or directed by the ENGINEER. Surfaces shall be free from fins, bulges, ridges, offsets, and honeycombing. Finishing by wood float, steel trowel, or similar methods is not required.

### **3.5 CURING**

- A. CLSM shall be kept damp for a minimum of 7 days or until final backfill is placed.



### **3.6 PROTECTION**

- A. CLSM shall be protected from freezing for 72 hours after placement.
- B. No fill or loading shall be placed on CLSM until probe penetration resistance, as measured in accordance with ASTM C 803 exceeds 650 psi.
- C. CLSM shall be protected from running water, rain, and other damage until the Material has been accepted and final fill completed.

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**SECTION 03 60 00**  
**GROUT**

**PART 1 GENERAL**

**1.1 REQUIREMENTS**

- A. CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents.
- B. Unless indicated otherwise, grout shall be provided as listed in this Section whether indicated on the Contract Drawings or not.
- C. Grout in contact with potable water shall be NSF 61 certified.
- D. The following types of grouts are covered in this Section:
  - 1. Cement Grout
  - 2. Non-Shrink Grout – Class I (cement based)
  - 3. Non-Shrink Grout – Class II (cement based)
  - 4. Non-Shrink Epoxy Grout
  - 5. Epoxy Anchor Grout for Adhesive Anchors
  - 6. Topping Grout and Concrete/Grout Fill

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 01 60 00 Product Requirements
  - 3. Section 03 30 00 Cast-in-Place Concrete

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. American Society for Testing Materials (ASTM)
  - 1. ASTM C 33           Standard Specification for Concrete Aggregates
  - 2. ASTM C 136       Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
  - 3. ASTM C 150       Standard Specification for Portland Cement
  - 4. ASTM C 307       Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing
  - 5. ASTM C 494       Standard Specification for Chemical Admixtures for Concrete
  - 6. ASTM C 496       Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens
  - 7. ASTM C 531       Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes

8. ASTM C 579 Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
9. ASTM C 580 Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes
10. ASTM C 595 Standard Specification for Blended Hydraulic Cements
11. ASTM C 827 Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
12. ASTM C 881 Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
13. ASTM C 882 Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear
14. ASTM C 939 Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)
15. ASTM C 942 Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory
16. ASTM C 1090 Standard Test Method for Measuring Changes in Height of Cylindrical Specimens of Hydraulic-Cement Grout
17. ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
18. ASTM C 1157 Standard Performance Specification for Hydraulic Cement
19. ASTM C 1339 Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts
20. ASTM D 648 Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position
21. ASTM D 695 Standard Test Method for Compressive Properties of Rigid Plastics

C. NSF INTERNATIONAL (NSF)

1. NSF/ANSI 61 Drinking Water System Components – Health Effects

#### 1.4 CONTRACTOR SUBMITTALS

- A. Submittals shall be furnished in accordance with Section 01 33 00 – Submittal Procedures.
- B. Provide the following submittals for each type of grout used on the project:
  1. Test reports accompanied by a manufacturer's statement that previously tested material is of similar type, quality, and manufacture as that which is proposed for use on this project shall be submitted for:
    - a. Cement
    - b. Aggregates
    - c. Retardants
    - d. Bonding compounds
    - e. Epoxy Resin
  2. Certifications that grout used on the project contain no chlorides or other chemicals that cause corrosion.

3. Where NSF/ANSI 61 approval is required, submit ANSI/NSF 61 certification letter for each type of grout indicating the product application requirements to maintain the certification.
4. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. ICBO/ES report shall be submitted for epoxy anchor grout for adhesive anchors.
5. Manufacturer's certification that non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
6. Submit manufacturer's written warranty as indicated herein.
7. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grout.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Grout and grout materials shall be stored in a dry shelter, protected from moisture, and for prepackaged grout, maintained in accordance with the manufacturer's recommendations.

## **1.6 QUALITY ASSURANCE**

- A. The work shall be subject to inspection at all times by OWNER and ENGINEER for the purpose of determining that the work is properly executed in accordance with this specification. Failure to detect defective workmanship or material during any interim inspection shall not constitute acceptance of workmanship and materials.
- B. All testing will be done by a testing laboratory at CONTRACTOR'S expense, except as otherwise indicated.
- C. Field Tests
  1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by ENGINEER.
  2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
  3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 31 00 - Cast-in-Place Concrete, at intervals during construction selected by ENGINEER.
  4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C 579, Method B, at intervals during construction selected by ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
- D. Construction tolerances shall be as indicated in Section 03 30 00 Cast-in-Place Concrete unless noted otherwise.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Cement: Portland cement shall be Type II or Type V per ASTM C 150 or Type IL(10)-MS or HS per ASTM C 595 and ASTM C 1157.
- B. Aggregate:
1. General: Aggregate shall be non-reactive and shall be washed before use. When sources of aggregate are changed, test reports shall be provided for the material from the new source prior to commencing grout work.
  2. Fine Aggregate: Fine aggregate shall be sand or crush stone conforming to ASTM C 33 as modified herein. When tested in accordance with ASTM C 136, gradation shall be such that 100 percent by weight passes a No. 8 sieve and not less than 45 percent by weight passes a standard No. 40 sieve. Variation from the specified gradation in individual tests will be accepted if the average of three consecutive tests is within the following variation:

Standard Sieve	Permissible Variation in Individual Test
No. 30 or coarser	2% by weight
No. 50 or finer	0.5% by weight

C. Admixtures

1. General: Admixtures shall be compatible with the grout and shall comply with the manufacturer's recommendations. Admixtures shall be added to the grout mix separately.
2. Water Reducing Retarder: Water reducing retarder shall comply with ASTM C 494, Type D and shall be **Master Builders (BASF) MasterSet R 300, Sika Corporation Plastiment**, or approved equal.
3. Lubricant: Lubricant additive for cement pressure grouting shall be **Sika Intraplast**, or approved equal.

D. Water:

1. Water for washing aggregate, for mixing and for curing shall be potable, shall not contain more than 1,000 mg/L of chlorides as Cl, nor more than 1,300 mg/L of sulfates as SO<sub>4</sub>, and shall not contain impurities which may change the setting time by more than 25 percent or a reduction of more than 5 percent of the compressive strength of the grout at 14 days when compared to the results for grout made with distilled water.

### 2.2 CEMENT GROUT

- A. Application: Surface repairs of concrete.
- B. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white Portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4000 psi.

- C. Cement grout materials shall be as indicated in Section 03 30 00 Cast-in-Place Concrete.

## 2.3 NON-SHRINK GROUT

### A. General

1. Non-shrink cementitious grout shall be a flowable, prepackaged, inorganic, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used. The manufacturer shall have at least 10 years' experience in the manufacture of cement-based grouts. The manufacturer shall provide technical services and provide a representative at the jobsite for product training prior to product installation.
2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the application.
3. Grout shall not contain chlorides or additives that may contribute to corrosion.
4. Grout shall be formulated to be used at any consistency from fluid to plastic.
5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
  - a. Minimum tensile splitting strength of 500 psi per ASTM C 496.
  - b. Minimum flexural strength of 1,000 psi per ASTM C 580.
  - c. Minimum bond strength (concrete to grout) of 1,900 psi per modified ASTM C 882.
  - d. Grout shall be certified for use in freeze/thaw environments.

### B. Class I Non-Shrink Grout

1. Application: Anchor bolts and reinforcing steel required to be set in grout in which the average working or operating temperature will be over 100 degrees F or in high fire risk areas; Beam and column (1 or 2 story) base plates less than 16-inches in the least dimension; Storage tanks and other non-motorized equipment and machinery under 30 horsepower; Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.; Repair of holes, defects, and around the annular space of pipe penetrations in concrete members which are not water bearing and not in contact with soil or other fill material; and any other location not specifically listed in this Section or on the Contract Drawings.
2. Class I non-shrink grout shall have a minimum 28 Day compressive strength of 5,000 psi when mixed at a fluid consistency.
3. Class I non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
4. Grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827. The grout when tested shall not bleed or segregate at maximum allowed water.
5. Grout shall have no shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with ASTM C 1090.
6. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
7. Class I Non-Shrink Grout shall be **Five Star Grout by Five Star Products, Sikagrout 212 by Sika Corporation, CB-G PG by Hilti**, or equal.

### C. Class II Non-Shrink Grout

1. Application: Column base plates (greater than 2 story or larger than 16-inches in the least dimension); under precast concrete elements; and repair of holes, defects, and around the annular space of pipe penetrations in concrete members which are water bearing or in contact with soil or other fill materials.
2. Class II non-shrink grout shall be a high precision, fluid, extended working time, grout. The minimum 28-Day compressive strength shall be 7,500 psi, when mixed at a fluid consistency.
3. Grout shall have no shrinkage (0.0%) and a maximum volume change of 0.08% at 28 days when tested in accordance with ASTM C 1090.
4. Class II non-shrink grout shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C 827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 1107.
5. Class II non-shrink grout shall meet the requirements of ASTM C 1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C 939.
6. The grout when tested shall not bleed or segregate at maximum allowed water content.
7. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
8. Class II non-shrink grout not in contact with potable water shall be **Five Star Fluid Grout 100 by Five Star Products, Crystex by L&M Construction Chemicals**, or equal.
9. Class II non-shrink grout in contact with potable shall be NSF 61 certified and shall be **SikaGrout 928 (formerly known as Masterflow 928), Euclid Hi-Flow Grout, Dayton Superior Sure -Grip High Performance Grout**, or approved equal.

## 2.4 NON-SHRINK EPOXY GROUT

- A. Application: Pumps over 1,000 horsepower, unless indicated otherwise.
- B. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
- C. Epoxy grout shall have a maximum early age height change of 4.0% expansion and shall have no shrinkage (0.0%) in accordance with ASTM C 827, (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1).
- D. Epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than  $18 \times 10^{-6}$  in/in F when tested according to ASTM C 531.
- E. The epoxy grout shall develop a minimum compressive strength of 9,000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C 579, method B.



- F. The mixed epoxy grout shall have a minimum working life of 90 to 120 minutes at 70 degrees F.
- G. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C 1339.
- H. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the application. Do not reduce aggregate loading or add solvents to increase flowability.
- I. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:
  - 1. Minimum bond strength to concrete of 3,000 psi per ASTM C 882 modified.
  - 2. Minimum bond strength to steel of 1,700 psi per ASTM C 882 modified.
  - 3. Minimum flexural strength of 2,500 psi per ASTM C 580.
  - 4. Minimum tensile strength of 2,000 psi per ASTM C 307.
- J. Non-shrink epoxy grout shall be **Five Star DP Epoxy Grout by Five Star Products, Inc., Sikadur 42 Grout-Pak by Sika Corporation**, or equal.

## 2.5 EPOXY ANCHOR GROUT

- A. Application: Anchor bolts and reinforcing steel required to be set in grout that is not in high temperature or high fire risk areas.
- B. Epoxy anchor grout shall conform to ASTM C 881, Type IV, Class A, B, and C, Grade 3 with the exception of gel time.
- C. Heat deflection temperature shall be a minimum of 139 °F per ASTM D 648.
- D. Manufacturer shall certify that the epoxy anchor grout will maintain 90 percent of its strength up to a temperature of 125 °F.
- E. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.
- F. Epoxy anchor grout shall be capable of being used in submersed applications once cured.
- G. Minimum compressive strength shall be 12,000 psi per ASTM D 695.
- H. Overhead anchors and anchors in fire-resistive construction shall be cast-in anchors.
- I. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar. Embedment shall not exceed 67 percent of the member depth.
- J. Epoxy anchor grout shall be **Epcon C6+ by ITW Ramset/Red Head, Power-Fast Epoxy Injection Gel by Powers Fasteners, RE 500 by Hilti**, or equal.

## 2.6 TOPPING GROUT AND CONCRETE/GROUT FILL

- A. Where fill is thicker than 3-inches, structural concrete as indicated in Section 03 31 00 - Cast-in-Place Concrete, may be used when accepted by ENGINEER.
- B. Grout for topping of slabs and concrete/grout fill for built-up surfaces of tank, channel, and basin bottoms shall be composed of cement, fine aggregate, coarse aggregate, water, and admixtures proportioned and be mixed as indicated. Materials and procedures indicated for normal concrete in Section 03 31 00 - Cast-in-Place Concrete, shall apply unless indicated otherwise.
- C. Topping grout and concrete/grout fill shall contain a minimum of 564 pounds of cement per cubic yard with a maximum water cement ratio of 0.45. Topping grout in clarifiers shall contain between 750 and 800 pounds of cement per cubic yard with a maximum water cement ratio of 0.42.
- D. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

- E. Final mix design shall be as determined by trial mix design as indicated in Section 03 30 00 - Cast-in-Place Concrete.
- F. Topping grout and concrete grout/fill shall contain air-entraining agent per Section 03 30 00 – Cast-in-Place Concrete.
- G. **Strength:** Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 4,000 psi.

## 2.7 CONSISTENCY

- A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the application.
- B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping or other similar means until sound, clean concrete surface is achieved.
- B. Rough concrete lightly, but not enough to interfere with placement of grout.
- C. Remove foreign materials from metal surfaces in contact with grout.
- D. Align, level, and maintain final positioning of components to be grouted.

### **3.2 GENERAL**

- A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on-Site technical assistance within 72 hours of request, as part of the WORK.
- B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by ENGINEER.
- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 30 00 – Cast-in-Place Concrete. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.
- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

### **3.3 GROUTING PROCEDURES**

- A. **General:** Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
  - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
  - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and

- the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by ENGINEER, alternate grouting methods shall be submitted for acceptance by ENGINEER.
3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.

#### C. Drilled Anchors and Reinforcing Bars

1. General
  - a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions. Holes shall be roughened with a brush on a power drill and cleaned. Drilled anchors shall not be installed until the concrete has reached the required 28 Day compressive strength. Anchors shall not be loaded until the grout has reached its indicated strength in accordance with the manufacturer's instructions.
  - b. CONTRACTOR shall identify position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in coring and drilling to avoid damaging existing reinforcing or embedded items. Notify ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.
2. Epoxy Adhesive Anchors
  - a. Grout shall be proportioned and mixed with automatic equipment.
  - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 8 diameters for threaded rod or 12 diameters for reinforcing or smooth bars.
  - c. Holes required for grouting shall be blown or vacuumed clean and are to be free of dust and standing water. Horizontal holes for grouting are to be drilled at a slight downward angle and with the inserted dowel or bolt bent to match.
3. Cement Based Non-Shrink Grout
  - a. In places of high temperature or fire hazard, anchor bolts shall be grouted in using cement based non-shrink grout, Class I.
  - b. Unless otherwise indicated, embedment shall be sufficient to develop the ultimate tensile strength of the anchor or reinforcing bar per the manufacturer's ICBO/ES report, but shall not be less than 16 diameters for threaded rod or 24 diameters for reinforcing or smooth bars.
  - c. When the bolt diameter is one-inch or less, the hole diameter should be a minimum of 2-inches. When the bolt diameter is greater than one-inch, the hole diameter should be at least twice the bolt diameter.
  - d. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
  - e. The non-shrink grout should be placed in the holes in a non-sag (trowelable) consistency. The grout should be placed in the holes before the anchor and then the anchor inserted and vibrated to ensure proper coverage.

#### D. Topping Grout and Concrete/Grout Fill

1. Mechanical, electrical, and finish Work shall be completed prior to placement of topping or concrete/grout fill. To ensure bonding to the base slab, the base slab shall be given an exposed aggregate finish. Alternatively, where accepted by ENGINEER, the base slab shall be given a roughened textured surface by a close-spaced rake while the surface is green. After curing, high pressure washing shall expose the aggregates and produce not less than a 3/16-inch amplitude roughness. Jackhammers or chipping hammers shall not be used.
2. The minimum thickness of grout topping and concrete/grout fill shall be one-inch. Where the finished surface of concrete/grout fill is to form an intersecting angle of less than 45 degrees with the concrete surface it is to be placed against, a key shall be formed in the concrete surface at the intersection point. The key shall be a minimum of 3-1/2 inches wide by 1-1/2 inches deep.
3. The base slab shall be thoroughly cleaned and wetted to saturated surface dry (SSD) condition per the International Concrete Repair Institute (ICRI) -- Technical Guide for Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays, prior to placing topping and fill. No topping concrete shall be placed until the slab is completely free from standing pools or ponds of water. A thin coat of neat cement grout shall be broomed into the surface of the slab just before topping or fill placement. The neat cement grout shall not be allowed to dry before topping placement. If it does dry, it must be immediately removed using wet stiff brooms and reapplied. The topping and fill shall be compacted by rolling or thorough tamping, brought to established grade, and floated. Grouted fill for tank and basin bottoms where scraping mechanisms are to be installed shall be screeded by blades attached to the revolving mechanism of the equipment in accordance with the procedures outlined by the equipment manufacturer after the grout is brought to the established grade. Coat surface with evaporation retardant as needed to prevent plastic shrinkage cracks.
4. Topping grout placed on sloping slabs shall proceed uniformly from the bottom of the slab to the top, for the full width of the placement.
5. The surface shall be tested with a straight edge to detect high and low spots that shall be immediately eliminated. When the topping or fill has hardened sufficiently, it shall be steel troweled to a smooth surface free from pinholes and other imperfections. An approved type of mechanical trowel may be used as an assist in this operation, but the last pass over the surface shall be by hand-troweling. During finishing, no water, dry cement, or mixture of dry cement and sand shall be applied to the surface.
6. As soon as topping or fill finishing is completed, coat surface with curing compound. After the topping is set and sufficiently hard in clarifiers and where required by ENGINEER, the tank shall be filled with sufficient water to cover the entire floor for 14 days.

### 3.4 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

### **3.5 CURING**

- A. Cement based grouts shall be cured per 03 30 00 – Cast-in-Place Concrete and per the manufacturer's recommendations.

- END OF SECTION -

**SECTION 04 22 00**  
**CONCRETE UNIT MASONRY**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This Section covers Concrete Masonry Unit (CMU) and appurtenant work.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 03 20 00 Concrete Reinforcement
3. Section 03 30 00 Cast-in-place Concrete
4. Section 07 21 00 Insulation
5. Section 07 92 00 Joint Sealants
6. Section 09 90 00 Painting and Finishes

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICA CONCRETE INSTITUTE (ACI)

1. ACI SP-66 ACI Detailing Manual
2. ACI 530 Building Code Requirements for Masonry Structures
3. ACI 530.1 Specifications for Masonry Structures

C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
2. ASTM A 951 Standard Specification for Steel Wire for Masonry Joint Reinforcement
3. ASTM A 1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
4. ASTM C 90 Standard Specification for Load-Bearing Concrete Masonry Units
5. ASTM C 140 Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
6. ASTM C 144 Standard Specification for Aggregate for Masonry Mortar
7. ASTM C 150 Standard Specification for Portland Cement
8. ASTM C 207 Standard Specification for Hydrated Lime for Masonry Purposes
9. ASTM C 270 Standard Specification for Mortar for Unit Masonry
10. ASTM C 404 Standard Specification for Aggregates for Masonry Grout
11. ASTM C 476 Standard Specification for Grout for Masonry
12. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
13. ASTM C 652 Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale)

- 14. ASTM C 1019 Standard Test Method for Sampling and Testing Grout
- 15. ASTM C 1314 Standard Test Method for Compressive Strength of Masonry Prisms
- 16. ASTM C 1384 Standard Specification for Admixtures for Masonry Mortars
- 17. ASTM D 226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
- 18. ASTM D 2000 Standard Classification System for Rubber Products in Automotive Applications
- 19. ASTM D 2287 Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
- 20. ASTM E 514 Standard Test Method for Water Penetration and Leakage Through Masonry
- 21. ASTM E 518 Standard Test Methods for Flexural Bond Strength of Masonry

**D. NATIONAL CONCRETE MASONRY ASSOCIATION (NCMA)**

- 1. NCMA-TEK 45 Removal of Stains from Concrete Masonry Walls

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Submit manufacturer's product data for each type of masonry unit, accessory, and other manufactured products, including certifications that each type complies with specified requirements and color samples. Include in the submittal dimensioned drawings for each type of block to be used on the project including, but not limited to, standard field block, lintel block, end block, caps, etc. Submit certificates showing compliance to the specifications for reinforcing steel, manufacturer's literature for anchor ties and any other accessories used, grout and mortar mix design, samples for mortar color selection, and manufacturer's literature for mortar and grout admixtures used along with CONTRACTOR's proposed usage details.
- C. Three sample specimens of the masonry units proposed for incorporation into the project shall be submitted to ENGINEER.
- D. Shop Drawings: Submit shop drawings showing elevations of each wall indicating type, layout of units, and location of control joints. Submit shop drawings showing fabrication, bending, and placement of reinforcement bars, complying with ACI SP-66. Show bar schedules, diagrams of bent bars, stirrup, spacing, lateral ties, and other components required for fabrication and placement of masonry reinforcement.
- E. Submit mix designs and test data for mortar and grout.
- F. Submit product data for premolded control joint strips and joint sealant and insulation material.
- G. A minimum 4-ft square free-standing mock-up sample panel shall be prepared for approval before starting masonry work. Masonry construction may not proceed until ENGINEER and OWNER approves the mock-up. The panel shall remain at the site for reference until masonry work is completed. Upon completion and acceptance of the Project, CONTRACTOR shall demolish and dispose of the mock-up offsite at an approved facility.



## 1.5 QUALITY ASSURANCE

- A. Concrete Masonry Units (CMU) shall be sampled and tested in accordance with ASTM C 140.
- B. CONTRACTOR shall have mortar and grout tested to assure compliance with the Specifications and the governing codes by a testing laboratory approved by ENGINEER. The test reports shall be submitted to ENGINEER.
  - 1. Tests shall be taken at the following times:
    - a. At commencement of masonry work, at least 2 samples each of mortar and grout shall be taken on 3 successive days.
    - b. At any change in materials or job conditions, at least 2 samples of each modified material, grout and mortar shall be tested.
    - c. Make four (4) random tests each of mortar and grout. The random test samples shall be taken when requested by ENGINEER.
    - d. The costs of tests shall be paid by CONTRACTOR as part of the work. The costs of additional tests, when required to verify compliance when requested by OWNER or ENGINEER, will be paid by OWNER. When tests do not verify compliance, the cost of additional tests shall be paid by CONTRACTOR.
  - 2. Samples shall be stored in a moist environment until tested, unless directed otherwise by ENGINEER or the testing laboratory. Testing for mortar shall be in accordance with ASTM C 270. Testing for grout shall be in accordance with ASTM C 1019.
- C. CONTRACTOR shall test the masonry units to assure compliance with the specifications and governing codes. Testing will be by a laboratory approved by ENGINEER.
  - 1. Testing will be made of the following items:
    - a. At the time of the construction of the sample panel, at least 3 masonry units shall be tested for each type of block, except separate tests are not required for block which only varies by texture.
    - b. At any change in materials during construction, at least 3 masonry units shall be tested.
    - c. Additional sets of at least 3 masonry units shall be tested whenever, in the judgment of ENGINEER, additional tests are necessary to determine the quality of the material.
    - d. CONTRACTOR shall submit a letter of certification from the masonry unit supplier at the time of, or prior to, delivery of the materials to the site that the materials used in construction are representative of the materials used to construct the prisms.
  - 2. The masonry units shall be sampled and tested in accordance with ASTM C 140.
- D. Whenever required under the provisions of the Building Code, the work shall be subject to inspection by a Special Inspector selected by ENGINEER and approved by the local building code representative having jurisdiction. The costs of such inspections will be paid by OWNER. The Special Inspector will work under the supervision of ENGINEER.
- E. Cold weather construction shall be per ACI 530.1, IBC Section 2104.3, and the local code requirements, whichever is more stringent.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. CONTRACTOR shall be responsible to deliver, handle, and store masonry units by means which will prevent mechanical damage and deterioration due to moisture, temperature changes, and corrosion. CONTRACTOR shall provide protection which will limit moisture absorption of concrete masonry units to the maximum percentage specified for Type I units for the average relative humidity at the project site, as reported by the nearest National Weather Service station.
- B. Cementitious materials shall be stored off the ground and protected from moisture.
- C. Aggregates shall be stored in a manner which will preserve grading characteristics.
- D. Masonry accessories shall be stored to prevent corrosion, dirt accumulation, and other deterioration.

## **1.7 PROJECT CONDITIONS**

- A. Cold Weather Protection: Do not lay masonry units when outside air temperature is below 40 degrees F.
  - 1. Grouted construction: On any day when the minimum anticipated nighttime temperature is 32 degrees F or less, in addition to complying with general procedures above, grout materials shall be heated to 90 degrees F to produce an in-place grout temperature of not less than 70 degrees F at end of workday. Protective blankets or enclosures shall remain in place for not less than 48 hours after placement of masonry units.
  - 2. Water: Water for mortar or grout shall not be heated to more than 160 degrees F.
- B. Hot-Weather Protection: Cover or shade masonry units and mortar materials and use cool water for mortar whenever ambient air temperature is 90 degrees F or greater. At air temperatures of 85 degrees F or above, if relative humidity is less than 30 percent or wind is in excess of 15 miles per hour, provide protection by immediately covering newly constructed walls by providing windbreaks, or by using fog spray to reduce rate of evaporation.

## **PART 2 PRODUCTS**

### **2.1 CONCRETE MASONRY UNITS**

- A. Concrete Block: Comply with referenced standards for types required, and as follows:
  - 1. Unit, Grade and Type: Concrete Masonry Units (CMU) shall conform to the requirements of the following table:

Unit	ASTM	Grade	Type	Minimum Net Area <sup>(1)</sup> Compressive Strength (psi)
Concrete Masonry Unit (CMU)	C 90	Lightweight	Hollow	2,000
Note: (1) Average of 3 units				

2. Size: The size of masonry units shall be as indicated on the Contract Drawings. Special shapes and sizes shall be provided as required, whether or not specifically indicated on the Contract Drawings as special.
3. Surfaces: Special surface texture or architectural faces shall be provided where indicated on the Contract Drawings.
4. Color: Where the finished surface will be visible, masonry units shall have colors as indicated on the Contract Drawings. Where colors are not specified, OWNER shall determine colors to be provided.

## 2.2 MATERIALS

- A. Portland Cement: ASTM C 150, Type II or IIA.
  1. Type III may be substituted during cold-weather construction.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Aggregate for Mortar: Sand conforming to ASTM C 144.
- D. Aggregate for Grout: ASTM C 404.
- E. Admixture for grout, if used, shall be **Sika Grout Aid by Sika Corp.**, or approved equal.
- F. Water: Clean and potable.
- G. Masonry cleaner shall be a non-acidic cleaner, **SafEtch by Prosoco, Inc.**, or approved equal.
- H. Accelerating Admixture: Non-chloride admixture for use in mortar mixes during cold weather, proportioned and mixed to comply with directions of manufacturer.
  1. Products: The following products, provided they comply with requirements of ASTM C 1384 and the contract documents, will be among those considered acceptable.
    - a. MORSET by Grace Construction Products
    - b. or approved equal
- I. Water-repellant and efflorescence control admixture.
  1. All exterior masonry units shall utilize a water-repellant and efflorescence control admixture as recommended by the manufacturer to obtain ASTM E 514 test extended to 72 hours, class E rating.

2. Admixtures shall be MasterPel 240 (Rheopel Plus) by BASF, Eucon Blocktite by Euclid Chemical Company, or approved equal.
- J. Integral water repellant admixture is required for mortar for exterior masonry units and shall be **MasterPel 240MA (Rheopel Plus Mortar Admixture) by BASF, Blocktite Mortar Admixture by Euclid Chemical Company**, or approved equal.

## 2.3 REINFORCEMENT AND ANCHORAGE

- A. Reinforcing Bars shall be in accordance with Section 03 20 00 – Concrete Reinforcement.
- B. Joint Reinforcement and Anchorage Materials: shall comply with ASTM A 951 and the following general requirements for materials required in joint reinforcement and anchorage devices.
  1. Steel wire: ASTM A 1064.
    - a. Zinc coating: ASTM A 641 Class 1.
    - b. Application: Use at interior locations.
- C. Joint Reinforcement: Provide welded-wire units prefabricated into straight lengths of not less than 10 feet, with deformed continuous side rods and plain cross rods, and as follows:
  1. Width: Approximately 1-1/2 inches less than nominal wall width, providing not less than 1/2-inch mortar coverage on each exposure.
  2. Wire sizes:
    - a. Side rod diameter: 0.1483 inch.
    - b. Cross rod diameter: 0.1483 inch.
  3. Configuration:
    - a. Applications of single unit width: Ladder design, cross rods at not more than 16 inches on center.
    - b. Corners: Provide prefabricated L- and T-shaped units.

## 2.4 MISCELLANEOUS MASONRY ACCESSORIES

- A. Premolded Control Joints Strips: Joints designed to fit standard sash block and to maintain lateral stability in masonry wall, of size and configuration indicated or as required for conditions, and as follows:
  1. Styrene-butadiene rubber compound complying with ASTM D 2000, 2AA-805, or
  2. Polyvinyl chloride complying with ASTM D 2287, Type PVC 654-4.
- B. Bond Breaker Strips: Asphalt-saturated organic roofing felt complying with ASTM D 226, Type 1 (No. 15 asphalt).
- C. Rebar Positioners: Rebar positioners shall be cold drawn steel 9 gauge wire, mill galvanized. Minimum tensile strength shall be 80,000 psi, yield point 70,000 psi minimum. Positioners shall be RB-Rebar Positioner, **RB-8 for 8-inch block, RB-10 for 10-inch, or RB-12 for 12-inch block as manufactured by Hohmann & Barnard, Inc.**, or approved equal.

- D. Joint Sealant: Provide joint sealants in accordance with Section 07 92 00.

## **2.5 MORTAR AND GROUT MIXES**

- A. General: Do not use admixtures unless indicated and approved by ENGINEER. Do not use calcium chloride in mortar or grout mixture.
- B. Mixing: Combine and thoroughly mix ingredients in a mechanical batch mixer; comply with referenced ASTM standards for mixing time and water content.
- C. Mortar for Unit Masonry: Comply with ASTM C 270 and IBC Section 2103.7, Proportion Specification, for types of mortar required, unless otherwise indicated.
  - 1. Limit cementitious materials in mortar to Portland cement and lime.
  - 2. Use Type S mortar for reinforced masonry. Compressive strength: 1800 psi @ 28 days.
  - 3. Mortar for use with colored masonry units shall have the integral color as approved by OWNER.
- D. Grout: Comply with ASTM C 476 and IBC 2103.10 for grout used in construction of unit masonry elements. Use grout of consistency indicated or as required at time of placement to fill completely all spaces intended to receive grout. Compressive strength: 2000 psi @ 28 days.
  - 1. Use fine grout in spaces less than 2 inches in least horizontal dimension, unless otherwise indicated.
  - 2. Use coarse grout in spaces 2 inches or more in least horizontal dimension, unless otherwise indicated.

## **2.6 MASONRY SEALERS (WATER RETARDENT)**

- A. Sealers shall be as specified in Section 09 90 00 - Painting and Finishes.

## **PART 3 EXECUTION**

### **3.1 GENERAL INSTALLATION PROCEDURES**

- A. Protect adjacent construction with appropriate means from mortar droppings and other effects of laying of concrete masonry units.
- B. Thoroughly clean foundations of laitance, grease, oil, mud, dirt, mortar droppings, and other objectionable matter.
- C. Review CMU material prior to installation and report any unsatisfactory units to the manufacturer. Set aside all units deemed unsatisfactory for further review by the testing agency and/or brick manufacturer's representative.
- D. Concrete Masonry Units: Do not wet concrete masonry units prior to laying, unless required for hot weather placement.
- E. Measurements for mortar and grout shall be accurately made. Shovel measurements are not acceptable. Mortar proportions shall be accurately controlled and maintained.

- F. Reinforcing: Before placing masonry reinforcing, remove loose rust, dirt, and other coatings.
- G. Masonry Thickness: Build masonry elements to full thickness shown.
  - 1. Build single-wythe walls to actual thickness of masonry units, using units of size indicated.
- H. Chases and Recesses: Build masonry to accommodate the work of other trades, including chases and recesses as shown or required. Provide not less than 8 inches of masonry between jambs of openings and chases and recesses.
- I. Leave openings for equipment to be installed in masonry. After installation of equipment, complete masonry work to match work immediately adjacent to opening.
- J. Cutting Masonry Units: Use motor-driven saws with diamond disc blade to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining work. Use dry cutting saws to cut concrete masonry units.
- K. Add foam insulation to open cells unless noted otherwise on the Contract Drawings. See Section 07 21 00 - Insulation. Perlite or similar loose-fill materials will NOT be permitted. Do not lay units more than 4 feet vertically ahead of units filled with insulation.
- L. Work shall be performed in accordance with ACI 530 and ACI 530.1, the latest edition of the IBC, and local governing codes for reinforced concrete hollow-unit masonry.
- M. CONTRACTOR shall set or embed anchors, bolts, reglets, sleeves, conduits, and other items as required.

### **3.2 CONSTRUCTION TOLERANCES**

- A. Variation from Plumb: Do not exceed the following construction tolerances in vertical elements, including surfaces of walls, columns, and arises:
  - 1. 1/4 inch to 10 feet
  - 2. 3/8 inch to one story height, or 20 feet, whichever is less, except 1/4 inch for external corners, expansion joints, and other highly conspicuous vertical elements
  - 3. 1/2 inch for 40 feet or more
  - 4. Plus or minus 1/4 inch in 10 feet, 1/2 inch maximum, for vertical alignment of head joints.
- B. Variation from Level: Do not exceed the following construction tolerances for bed joints and lines of exposed lintels, sills, parapets, horizontal grooves, and other conspicuous horizontal elements:
  - 1. 1/4 inch in one bay or in 20 feet maximum
  - 2. 1/2 inch in 40 feet or more
- C. Variation from Plan Lines: Do not exceed the following horizontal construction tolerances for related portions of columns, walls, and partitions:
  - 1. 3/8 inch in any bay of 16 feet maximum

2. 1/2 inch in 32 feet or more

D. Variation in Cross Section: Do not exceed the following masonry elements:

1. Minus 1/4 inch
2. Plus 1/2 inch

E. Variation in Mortar Joint Thickness: Do not exceed the following construction tolerances for thickness of mortar joints:

1. Bed joints: Plus or minus 1/8 inch
2. Head joints: Plus or minus 1/8 inch

### **3.3 MASONRY CONSTRUCTION - GENERAL**

A. Layout: Lay out masonry for accurate pattern bond, for uniform joint widths, and for accurate location of specific features before beginning actual construction. Avoid use of masonry units of less than 1/2 size. Do not use units with less than nominal 4 inch horizontal face dimensions at corners and jambs.

B. Pattern Bond: Lay exposed masonry in 1/2 running bond with vertical joints in each course centered on units in course above and below except where other bonds are indicated at special features.

1. Lay concealed masonry with all units in a wythe in running bond.
2. Bond and interlock each course of each wythe at corners.

C. Reinforced Concrete Unit Masonry: Maintain vertical continuity of core or cell cavities. Keep cavities clear of mortar, including bed area of first course, to provide minimum clear dimension indicated, to provide minimum clearance and grout coverage for vertical reinforcement bars, and to provide direct grout contact with supporting surfaces.

D. Stopping and Resuming Work: Lay masonry in proper sequence to avoid toothing. Rack walls back in each course at end of each day. Before resuming, clean exposed surfaces and remove loose masonry units and mortar.

E. Built-in Work: As work progresses, build in items indicated for installation in masonry, filling around built-in items solidly with masonry.

1. Fill spaces between metal frames and masonry elements solidly with mortar, unless otherwise indicated.

F. Install lintels of types indicated at all openings.

1. Bearing: Provide not less than 8 inches of bearing at each jamb unless otherwise indicated.
2. Reinforcement: At masonry openings greater than one foot in width, install horizontal joint reinforcement in 2 horizontal joints approximately 8 inches apart immediately above lintel and immediately below sill. Extend reinforcement which is in addition to required continuous joint reinforcement not less than 24 inches beyond jambs of the opening, except at control joints.

- G. Formwork: Provide temporary formwork and shores as required for temporary support of reinforced masonry elements. Construct formwork to shape line, and dimensions shown. Make sufficiently tight to avoid leakage of mortar and grout.
  - 1. Brace, tie, and support as required to maintain position and shape during construction and curing of reinforced masonry.
  - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other reasonable temporary loads that may be placed on them during construction.

### **3.4 MORTAR BEDDING AND JOINTING**

- A. Lay hollow masonry units with full mortar coverage on horizontal and vertical face shells. Bed webs in mortar in starting course and in all courses of piers, columns, and pilasters, and where adjacent to cells or cavities to be grouted or filled with concrete.
- B. Maintain joint widths indicated, except for minor variations required to maintain bond alignment. Except as otherwise indicated, maintain joint widths of 3/8 inch.
- C. Cut joints flush for masonry walls which are concealed or covered by other materials, unless otherwise indicated.
- D. Tool exposed joints slightly concave, using a jointer larger than joint thickness unless otherwise indicated.
- E. Remove masonry units disturbed after laying; clean and reset in fresh mortar. Do not pound corners of jambs to shift adjacent stretcher units which have been set in position. If adjustments are required, remove units, clean off mortar, and reset in fresh mortar.

### **3.5 CONTROL JOINTS/EXPANSION JOINTS**

- A. Provide control joints or expansion joints in masonry walls where shown on the Contract Drawings.
- B. Joints shall be full height and continuous in appearance.
- C. Run bond beams and bond beam reinforcing bars continuously through control joints. Stop horizontal reinforcing at expansion joints.
- D. Insert control joint filler in joints as wall is constructed.
- E. Insert 50% (or higher) compressible neoprene expansion joint material in expansion joints.

### **3.6 HORIZONTAL JOINT REINFORCEMENT OF SINGLE-WYTHE WALLS**

- A. General: Provide continuous horizontal joint reinforcement for all single-wythe masonry walls, unless otherwise indicated. Lap reinforcing a minimum of 6 inches.
- B. Install joint reinforcing in mortar joints at not more than 16 inches on center vertically.
- C. Cut or interrupt joint reinforcement at expansion joints.



- D. Provide continuity at corners and wall intersections by means of prefabricated L- and T-shaped sections. Cut and bend reinforcement units as directed by the manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### **3.7 INSTALLATION OF REINFORCEMENT**

- A. Preparation: Do not use reinforcement bars with kinks or bends not shown on Contract Drawings or final shop drawings. Do not use bars with cross section reduced due to excessive rusting and other causes.
- B. Placement: Position reinforcement bars accurately at spacings indicated. Support and secure vertical bars against displacement. Horizontal bars may be placed as the work progresses. Provide not less than the greater of either the bar diameter or 1 inch clear between bars. For columns, piers, and pilasters, provide a clear distance between vertical bars as indicated, but not less than 1-1/2 times the nominal bar diameter or 1-1/2 inches, whichever is greater.
- C. Splicing: Provide lapped splices at locations shown; do not splice at other points or by other methods, unless approved by ENGINEER. Provide not less than the minimum lap indicated, or as required by governing code.

### **3.8 GROUTING**

- A. Grouting Technique:
  - 1. Provide minimum clear dimension of 2 inches and minimum clear area of 8 square inches in vertical cores to be grouted. Place vertical reinforcement prior to laying concrete masonry units, extending above elevation of maximum pour height as required for splicing. Support in position at vertical intervals not exceeding 192 bar diameters or 10 feet, whichever is less.
  - 2. Grout shall be placed in all open areas of the masonry block as specified herein.
  - 3. Lay masonry units to maximum pour height, not to exceed 4 feet.
  - 4. Pour grout using chute or container with spout. Vibrate grout during placement. Place grout continuously; do not interrupt pouring operation for more than 1 hour. Terminate pour 1-1/2 inches below top of highest course in pour, except at tops of walls.
  - 5. Stop grout in vertical cells 1-1/2 inches below bond beam course. Place horizontal reinforcement in bond beams; lap at corners and intersections as shown. Place grout in bond beam course before filling vertical cores above bond beams.

### **3.9 REPAIR AND POINTING**

- A. Repair: Remove and replace masonry units which are loose, chipped, broken, stained, or otherwise damaged, or if units do not match adjoining units as intended. Provide new units to match adjoining units and install in fresh mortar or grout pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of mortar joints, enlarge any holes or voids except weep holes and completely fill with mortar. Point up all joints, including corners, openings, and adjacent work, to provide a neat and uniform appearance.

### **3.10 CLEANING AND PROTECTION**

- A. Clean masonry as follows after mortar is thoroughly set and cured:
  - 1. Remove large mortar particles by hand, using wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel, leaving half of panel uncleaned for comparison.
  - 3. Clean concrete unit masonry to comply with directions of masonry manufacturer and as recommended by NCMA in Tek Bulletin No. 45.
- B. Protection: CONTRACTOR shall protect all masonry until such time as the Work is completed and accepted by ENGINEER.

### **3.11 FINISH**

- A. Block shall be finished as per Section 09 90 00 - Painting and Finishes.

- END OF SECTION -

**SECTION 05 45 00**  
**MECHANICAL METAL SUPPORTS (PIPE SUPPORTS)**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This Section covers materials and installation of mechanical metal supports, pipe supports, hangers, guides, anchors, and appurtenances as specified and indicated.
- B. CONTRACTOR shall provide mechanical metal supports in accordance with this Section whether shown on the Contract Drawings or not.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 05 50 00 Miscellaneous Specialties
  - 3. Section 09 90 00 Painting and Finishes
  - 4. Section 33 05 03 Copper Pipe
  - 5. Section 33 05 05 Ductile Iron Pipe
  - 6. Section 33 05 07.1 PVC Pressure Pipe (ASMT 1785)
  - 7. Section 33 12 00 Mechanical Appurtenances
  - 8. Section 40 05 13.13 Steel Process Piping

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTING INDUSTRY (MSS)
  - 1. MSS SP-58 Pipe Hangers and Supports – Materials Design and Manufacture
  - 2. MSS SP-69 Pipe Hangers and Supports – Selection and Application
  - 3. MSS SP-89 Pipe Hangers and Supports – Fabrication and Installation Practices
  - 4. MSS SP-127 Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
- C. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
  - 1. ASME B 31.1 Power Piping
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 36 Standard Specification for Carbon Structural Steel
  - 2. ASTM A 47 Standard Specification for Ferritic Malleable Iron Castings
  - 3. ASTM A 48 Standard Specification for Gray Iron Castings
  - 4. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 5. ASTM A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and S

- |    |            |   |
|----|------------|---|
| 6. | ASTM A 575 | Steel Hardware<br>Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades |
| 7. | ASTM A 576 | Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality                 |

## 1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit complete shop drawings of mechanical supports, pipe supports, hangers and guides. Provide scaled shop drawings showing locations of the supports and detailed drawings for each support. Identify each type of hanger or support by the manufacturer's part number of figure on the drawing.
- C. Provide installation drawings and manufacturer's catalog information on each type of hanger and support.
- D. Provide structural calculations for special supports and anchors, stamped, and signed by a professional engineer registered in the State of Utah.

## PART 2 MATERIALS

### 2.1 GENERAL

- A. All pipe hangers and supports shall be manufactured to comply with MSS-SP-58, MSS-SP-569, MSS-SP-89 except as modified herein. Where applicable, design and manufacture must also conform to ANSI/ASME B31.1. Supports for plumbing or fire piping shall be in accordance with the latest edition of the applicable plumbing or fire code and the requirements of the local jurisdiction.
- B. Hangers, supports, anchors and restraints must be designed in accordance with MSS-SP-127 to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment. Piping supports and equipment must be considered as a total system and appropriate balance calculations made to determine load forces at critical stress points. Loading conditions to be considered may include, but are not limited to:
  - 1. The total load of pipe, fittings, valves, insulation, and any expected contents of the pipe.
  - 2. Thermal expansion and contraction
  - 3. Stress from cycling of equipment or process.
  - 4. Vibration transmitted to or from equipment or terminal connection.
  - 5. Wind, snow, or ice loading on outdoor piping
  - 6. Loading due to seismic forces
- C. Static and dynamic forces at points of attachments must be considered to help ensure structural integrity of buildings or equipment. Hangers and supports must be selected to minimize the effect of piping system loading on the structure.
- D. In general, piping shall be supported from structural members, such as walls, beams, columns, and slabs, using approved structural attachments. In situations where

approved attachments cannot be used, alternative attachments or substructure assemblies must receive approval by ENGINEER prior to installation. Prior approval by ENGINEER must be given before any cutting or drilling of building structural steel. Damage to the structure through welding, cutting, or drilling will not be permitted if it reduces the structure's strength below the established safety factor for the structure. Any additional structural steel required to properly support piping or equipment shall be furnished and installed by CONTRACTOR at no additional cost to OWNER.

## **2.2 SUPPORT MATERIALS**

- A. Pipe supports, hangers, guides, etc. shall be hot-dip galvanized carbon steel, unless noted otherwise on the Contract Drawings. Steel shall be in accordance with ASTM A 36, ASTM A 575, or ASTM A 576. Hot-dip galvanizing shall be in accordance with ASTM A 123 or ASTM A 153. Bases, rollers, and anchors shall be steel as described above or may be cast iron conforming to ASTM A 48. Pipe clamps shall be steel as described above or may be malleable iron conforming to ASTM A 47.
- B. Submerged supports, as well as piping in hydraulic structures within 24 inches of the high-water level, shall have supports, including hardware and anchors constructed of Type 316 stainless steel, unless noted otherwise on the Contract Drawings.
- C. Piping in chemical or corrosive areas shall have supports, including hardware and anchors constructed of Type 316 stainless steel or fiberglass reinforced plastic (FRP), unless noted otherwise on the Drawings.
- D. Supports fabricated from other materials specified on the Contract Drawings shall have a protective coating in accordance with the requirements of Section 09 90 00 – Painting and Finishes.

## **2.3 FLOOR MOUNTED SUPPORTS**

- A. Floor mounted pipe supports shall be the adjustable saddle support with stanchion, base and U-bolt or adjustable flange support type with stanchion and base. Pipe supports with stanchion and base plate shall be sized for the pipe or mechanical appurtenance it supports. All pipe supports shall have a 1-inch-high grouted pad to be used as a leveling base. Pipe supports shall be secured to the floor. A 1/4-inch-thick EPDM Rubber insulation pad shall be provided between the pipe and the U-Bolt.

## **2.4 SPRING-TYPE HANGERS**

- A. Spring-type hangers shall be provided for piping subject to vibration or vertical expansion/contraction such as engine exhaust piping. Design the spring-type hangers per the manufacturer's recommendations.

## **2.5 CONCENTRATED LOADS**

- A. Concentrated loads, such as meters, valves, and equipment, on PVC piping systems shall have supports on each side of the concentrated load.

## **2.6 CONCRETE ANCHORS**

- A. Anchors shall be in accordance with Section 05 50 00 – Miscellaneous Specialties.

## 2.7 MANUFACTURERS

- A. Mechanical Metal Support (pipe support) manufacturers shall be **Anvil (an ASC Engineered Solution), B-Line by Eaton (Cooper Industries), Utility Coatings & Fabrication, Piping Technology & Products, Inc. (PT&P)**, or approved equal. To be considered an approved equal, materials must be of similar diameter, thickness, and strength to the product specified.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Mechanical metal supports, pipe supports, hangers, guides, etc. shall be installed per the manufacturer's instructions and ASME B31.1 – Power Piping.
- B. Pipe supports shall be positioned in order to produce an orderly, neat piping system. Hanger rods shall be vertical without offsets.
- C. Hangers shall be adjusted to line up groups of pipes at the proper grade for drainage and venting as close to ceilings or roofs as possible and without interference with other work.
- D. Hangers shall be installed in a manner to prevent obstructing ladders, manhole covers, and access hatches.
- E. Set embedded inserts accurately in position and support them rigidly before concrete is placed and prevent displacement during and after placement of concrete.
- F. Provide separate hangers or supports at valves, meters, elbows, tees, and other equipment. Provide separate hangers on each both sides of each non-rigid joint or flexible coupling.
- G. Install piping without springing, forcing, or stressing the pipe or any connecting valves, pumps, or other pipe to which the pipe is connected.
- H. Hangers and supports for rigid plastic pipe shall be provided with a support shield to spread the load bearing surface.
- I. Use of wire hangers, perforated strap, hanging from unreinforced metal deck and cellular roof deck are not permitted.
- J. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.
- K. Galvanizing Field Repairs
  - 1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
  - 2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

### 3.2 SUPPORT LOCATION AND SPACING

- A. Supports for horizontal piping shall be spaced to prevent excessive sag, bending and stress in the piping. Spacing shall not exceed the maximum indicated spans.
- B. Maximum spans indicated in the tables below are for ambient temperatures or the temperatures listed for the materials and pipe wall thicknesses shown. Adjust the span spacing for different temperatures and/or pipe wall thicknesses per the manufacturer's recommendations.
- C. Install pipe supports on horizontal and vertical runs at the spacing shown or detailed on the Contract Drawings. If no spacing or rod sizes are given on the Contract Drawings or in the Specifications for a particular piping system, use the following tables or the recommendations of the support or pipe manufacturer.
1. Support Spacing for Steel Pipe (Section 40 05 13.13 – Steel Process Piping) Schedule 40 and Schedule 80:

Pipe Size (inches)	Maximum Span Water Service (feet)	Maximum Span Vapor Service (feet)	Minimum Hanger Rod Size (inches)
3/8 and smaller	4	5	3/8
1/2 through 1	6	8	3/8
1-1/4 through 2	8	10	3/8
2-1/2 through 3	10	14	1/2
3-1/2 through 4	10	15	5/8
6	12	20	3/4
8	12	24	3/4
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.			

2. Support Spacing for Copper Pipe (Section 33 05 03 – Copper Pipe) per MSS-SP-69, Table 3:

Pipe Size (inches)	Maximum Span Water Service (feet)	Maximum Span Vapor Service (feet)	Minimum Rod Size (inches)
1/2	5	6	3/8
3/4	5	7	3/8
1	6	8	3/8
1-1/4	7	9	3/8
1-1/2	8	10	3/8
2	8	11	3/8
2-1/2	9	12	1/2
3	10	14	1/2
3-1/2	11	15	1/2
4	12	16	5/8
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.			

3. Support Spacing for PVC Pipe (Section 33 05 07.1 – Polyvinyl Chloride Pipe) Schedule 40 and Schedule 80. The table below is meant as a general guideline and it is recommended that the pipe manufacturer be consulted for specific spacing recommendations relating to their pipe, load conditions, operating temperatures, and service conditions.

Pipe Size (inches)	Maximum Span Schedule 40 (feet)				Maximum Span Schedule 80 (feet)			
	60°F	80°F	100°F	120°F	60°F	80°F	100°F	120°F
1/2	4.5	4.5	4	2.5	5	4.5	4.5	3
3/4	5	4.5	4	2.5	5.5	5	4.5	3
1	5.5	5	4.5	3	6	5.5	5	3.5
1-1/4	5.5	5.5	5	3	6	6	5.5	3.5
1-1/2	6	5.5	5	3.5	6.5	6	5.5	3.5
2	6	5.5	5	3.5	7	6.5	6	4
2-1/2	7	6.5	6	4	7.5	7.5	6.5	4.5
3	7	7	6	4	8	7.5	7	4.5
4	7.5	7	6.5	4.5	9	8.5	7.5	5
6	8.5	8	7.5	5	10	9.5	9	6
8	9	8.5	8	5	11	10.5	9.5	6.5
10	10	9	8.5	5.5	12	11	10	7
12	11.5	10.5	9.5	6.5	13	12	10.5	7.5
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.								
Data taken from Anvil International, Inc. Catalog PH-2006, page PH-213 and is based on continuous span and for un-insulated line carrying fluids of specific gravity up to 1.00.								

4. Supports for Ductile Iron Pipe (Section 33 05 05 – Ductile Iron Pipe) should be installed in locations shown on the Drawings with a minimum of one support per 20-foot length of pipe. If longer spans are required, the supports should be designed in accordance with DIPRA – Design of Ductile Iron Pipe on Supports and the pipe manufacturer's recommendations. Supports should be cradle type with a saddle angle of 120 degrees. The table below shows the recommended maximum spans per US Pipe – Long Span and Bridge Crossing Pipe guidelines.

Pipe Size (inches)	Maximum Span Water Service (feet)
6	28
8	30
10	30
12	35
14	35
16	40
18	42
20 to 64	45
Note: These spacings do not apply where span calculations are made or where there	



are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.

5. Support Spacing for Brass Pipe (Section 40 05 13.33 – Brass Process Piping) Schedule 40 and Schedule 80. The table below is meant as a general guideline and it is recommended that the pipe manufacturer be consulted for specific spacing recommendations relating to their pipe, load conditions, operating temperatures, and service conditions.

Pipe Size (inches)	Maximum Span Water Service (feet)
Up to 1-1/4"	6
2" thru 24"	10
Note: These spacings do not apply where span calculations are made or where there are concentrated loads between supports such as flanges, valves, specialties, etc. or changes in direction requiring additional supports.	

6. Support spacing for other pipe materials shall be based on recommendations from the pipe manufacturer.
7. Provide sway bracing for hangers where shown on the Contract Drawings. If no bracing is shown, provide bracing at 10-foot maximum center-to-center intervals.

- END OF SECTION -

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**SECTION 05 50 00**  
**MISCELLANEOUS SPECIALTIES**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This section covers materials, fabrication, and installation of miscellaneous metals, specialties, and appurtenances as specified and indicated.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 09 90 00 Painting and Finishes

**1.3 RELATED SPECIFICATIONS**

- A. Fabrication and erection of the platforms, ladders and stairs shall be in accordance with the Specification for the Design, Fabrication and Creation of Structural Steel for Buildings of the latest edition of the A.I.S.C. Manual, and Section 1910.27 of the latest edition of the OSHA standards, except as specified herein.

**1.4 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)
1. Manual of Steel Construction
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 36 Standard Specification for Carbon Structural Steel
  2. ASTM A 53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  3. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  4. ASMT A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
  5. ASTM A 276 Standard Specification for Stainless Steel Bars and Shapes
  6. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 psi Tensile Strength
  7. ASTM A 615 Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
  8. ASTM F 593 Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
  9. ASTM F 594 Standard Specification for Stainless Steel Nuts
- D. NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

- E. AMP 510      Metal Stairs Manual

## **1.5 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit complete shop drawings of fabricated items, such as vents, ladders, stairs, platforms, beams, pipe supports, and miscellaneous metals for approval to Engineer.
- C. Shop drawings shall conform to AISC recommendations and specifications, and shall show holes, and the like, as may be required for other parts of the work.
- D. Shop drawings shall include complete details of members and connections, anchor bolt layouts, schedules for fabrication procedures, and diagrams for the sequence of erection.
- E. Submit manufacturer's catalog data and dimensional drawings for lifting eyebolts and inserts; ladder safety posts, manhole covers and frames, and anchor bolts.
- F. Submit ICC ES Evaluation Reports for adhesive and wedge anchors and installer qualifications and procedures.

## **1.6 QUALITY ASSURANCE**

- A. Field Measurements: Take field measurement prior to preparation of Shop Drawings and fabrication to ensure proper fitting of the Work.
- B. Shop Assembly: Preassemble items in the shop to the greatest extent possible, so as to minimize field splicing and assembly of units at the project site. Disassemble units to the extent necessary for shipping limitations.
- C. Fabricator Qualifications: Fabricators shall be regularly engaged in the manufacture of the types of steel specialties they are providing and shall have at least 5 years of experience in this specialty.
- D. Qualifications: Qualify welding operators in accordance with the requirements of current AWS Standard. Provide certification that all welders employed on or to be employed for the Work have satisfactorily passed AWS qualification tests within the previous 12 months. Ensure that all certifications are kept current.

## **PART 2 MATERIALS**

### **2.1 CARBON STEEL**

- A. Materials for bolted or welded steel construction shall conform to ASTM A 36.

### **2.2 STAINLESS STEEL**

- A. All bolts, expansion bolts, nuts, washers, and expansion sleeve inserts used to attach metal supports shall be stainless steel Type 316.
- B. All interior tank ladders, wall conduits, louvers, and other items required shall be

stainless steel unless noted otherwise.

## 2.3 HOT-DIPPED GALVANIZED

- A. All vents, stairs, vault ladders, handrail, guardrail, stringers, beams, and miscellaneous items shall be galvanized (zinc coated) unless noted otherwise.
- B. Zinc coating for plates, bolts, anchor bolts, and threaded parts shall in in accordance with ASTM A 153. Structural steel shall be zinc coated in accordance with ASTM A 123.

## 2.4 BOLTS

- A. Steel anchor and connection bolts for non-corrosive service shall conform to ASTM A 307, Grade A or B, unless otherwise noted. Bolts shall be hot-dip galvanized and provided with self-locking nuts or lock washers and plain nuts.
- B. Steel anchor and connection bolts for corrosive service shall be fabricated from stainless steel, unless indicated otherwise in the specifications or on the Contract Drawings. Corrosive service locations are listed below.
  - 1. Buried locations
  - 2. Submerged locations
  - 3. Locations subject to occasional flooding
  - 4. Inside hydraulic structures
  - 5. Chemical handling areas
  - 6. Inside buried manholes, vaults, and structures that do not have a gravity drain or sump pump
  - 7. Inside trenches, containment walls, and curbed areas.
- C. The nuts shall be capable of developing the full strength of the bolts. Bolts and cap screws shall have hexagon heads and nuts shall be heavy hexagon series. Bolts and nuts shall be installed with washers from material matching the base material of bolts. Lock washers fabricated from the material matching the bolts shall be installed where indicated.
- D. The length of the bolts shall be such that the bolt extends at least 1/8 inch beyond the outside face of the nut before tightening, except for anchor bolts which shall be flush with the face of the nut before tightening.

## 2.5 LIFTING EYEBOLTS

- A. Locate eyebolts and concrete inserts over the centerline of the piping at locations shown on the Contract Drawings. Eyebolts and inserts shall have a minimum safety factor of 3 and be rated for a working load of 3,000 pounds.
- B. Provide inserts of the ferrule wing nut design with threads to match the eyebolts. Cast inserts in the roof slab of the vault at the locations identified on the Contract Drawings.

## 2.6 THREADED INSERTS

- A. Threaded inserts shall be of ductile iron construction with standard National Course (NC) or United National Course (UNC) threads. Inserts shall be cast-in-place at the locations shown on the Contract Drawings. Inserts shall be fabricated by **Meadow Burke**, or

approved equal.

## 2.7 ADHESIVE ANCHORS

- A. Unless otherwise indicated, drilled concrete or masonry anchors shall be adhesive anchors. No substitutions will be considered without an ICC ES Report verifying strength and material equivalency. Anchors used inside potable water reservoirs shall be ANSI/NSF 61 certified.
- B. Adhesive anchors shall be a two-component system consisting of an all-threaded anchor rod with nut and washer, and the adhesive capsule. Anchor rods shall be Type 304 stainless steel conforming to ASTM F 593 with nuts conforming to ASTM F 594. The adhesive capsules shall contain a polyvinyl or urethane methacrylate-based resin and accelerator within a sealed dual chamber foil capsule. Adhesive anchors shall be **Hilti HVA Capsule Adhesive Anchoring System**, or approved equal.

## 2.8 STEEL PIPE

- A. Pipe for guard posts shall be Schedule 40 and pipe for vault vents shall be Schedule 10 conforming to ASTM A 53, unless noted otherwise on the Contract Drawings, and shall be hot-dip galvanized.

## 2.9 LADDERS

- A. Ladders which may be partially or fully submerged or located inside a manhole or vault without a gravity drain or sump pump shall be fabricated entirely of Type 304 stainless steel. All ladder hardware and supports shall be Type 304 stainless steel. Ladders and hardware fully submerged or located inside a manholes or vault for wastewater facilities shall be Type 316 stainless steel.
- B. Other ladders shall be fabricated from carbon steel and hot-dip galvanized after fabrication unless noted otherwise on the Contract Drawings. All ladder hardware and supports shall be the same material as the ladder.
- C. All ladders without a permanently mounted exterior ladder extension shall be provided with a telescoping safety post. The post shall be fabricated of steel with a telescoping tubular section that locks automatically when fully extended. The upward and downward movement shall be controlled by a stainless-steel spring balancing mechanism. The telescoping safety post shall be fabricated from the same material and finish as the ladder. The telescoping posts shall be **LadderUP Safety Post by Bilco**, or approved equal.

## 2.10 VAULT VENTS

- A. Fabricate vault vents as shown on the Contract Drawings. Vault vents shall be welded steel construction and hot-dip galvanized after fabrication. Coating shall be in accordance with Section 09 90 00 – Painting and Finishes.

## 2.11 COVERS AND FRAMES

- A. Manhole covers and frames shall be cast iron and designed for AASHTO HS-20 loading, unless otherwise indicated. Castings shall be smooth, clean, and free from blisters,

blowholes, and shrinkage. Covers shall seat firmly into the frames without rocking. Covers and frames shall fit together evenly such that the cover fits flush with the surrounding finished surface.

#### 2.12 METAL STAIRS

- A. Metal stairs shall be composed of steel stringers and supports, unless otherwise noted on the Drawings. The stairs shall be fabricated in accordance with the standard practice of NAAMM AMP 510.
- B. Metal stairs shall be galvanized and as noted in the Contract Drawings.

#### 2.13 POLYPROPYLENE STEPS

- A. Polypropylene steps shall have a 1/2-inch ASTM A 615 grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have a tread width of 14-inches nominal.
- B. Steps shall be manufactured by **American Step Company, Inc., M.A. Industries, D & L Supply No. F-1981**, or approved equal.

#### 2.14 GRATING

- A. Grating shall be supported around all sides of an opening with support members. Unless otherwise indicated, grating supported on concrete shall have embedded angles that match the grating material. Grating shall be serrated bar grating, unless noted otherwise on the Contract Drawings.
- B. The grating shall be completely banded at edges and cutouts and the banding shall be welded to each cut bearing bar. The banding material and cross-section shall be the same as the bearing bars.
- C. Grating pieces shall be fastened to each support at a minimum of 2 locations.
- D. Grating deflection shall not exceed 1/4 inch or the span divided by 180, whichever is less.
- E. For standard duty grating, the loading to be used for determining stresses and deflections shall be the uniform load of the adjacent floor or 100 psf, whichever is greater, or a concentrated load of 1000 pounds. For heavy duty grating the loading used shall be in accordance with AASHTO HS-20.
- F. Standard duty grating shall be fabricated from steel and hot-dip galvanized, unless noted otherwise. Standard duty grating that will be submerged, partially submerged, or in a corrosive environment shall be fabricated entirely of Type 316 stainless steel. No single piece of standard duty grating shall weigh more than 80 pounds, unless noted otherwise on the Contract Drawings. All crossbars shall be welded into position.
- G. Heavy duty grating shall be fabricated from welded steel and hot-dip galvanized after fabrication. All crossbars shall be welded into position.
- H. Bar dimensions shall be 1-1/4 inch by 3/16 inch, minimum and shall be manufactured by **McNICHOLS, AMICO, Robertsons Grating Products**, or approved equal.

## 2.15 SAFETY STAIR NOSINGS

- A. Safety stair nosings shall be provided on concrete stairs and other locations indicated on the Contract Drawings.
- B. The nosings shall be 3 inches wide and fabricated from extruded aluminum with cast-in-abrasive strips and integral extruded anchors.
- C. The color of the cast abrasive shall be as selected by OWNER.
- D. The safety stair nosing shall be **Style 231-A by Amstep, XRS-3 by Grating Pacific, Type 9511 by Robertson Grating Products**, or approved equal.

## 2.16 STEEL PIPE HANDRAIL AND GUARDRAILS

- A. Railings shall conform to the Building Code and OSHA requirements.
- B. Handrails, brackets and related hardware shall be steel pipe and hot-dip galvanized after fabrication. Handrails, brackets, and related hardware that shall be submerged, partially submerged, or in a corrosive environment shall be fabricated from Type 316 stainless steel.

## PART 3 EXECUTION

### 3.1 GENERAL

- A. Except as otherwise shown, the design, fabrication, and erection of structural steel shall conform to the requirements of the American Institute of Steel Construction "Manual of Steel Construction".
- B. Install miscellaneous specialties as indicated on the Contract Drawings or as recommended by the manufacturer.
- C. Store materials above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.
- D. Clean surfaces of metalwork to be in contact with concrete of rust, dirt, grease, and other foreign matter before placing concrete.
- E. Set embedded metalwork accurately in position and support it rigidly before concrete is placed and prevent displacement during and after placement of concrete.
- F. Repair or replace metal items damaged during installation. Follow the manufacturer's procedures for repairing damaged surfaces.
- G. Welding shall be performed by metal-arc method or shielded metal arc method as per the American Welding Society's (AWS) "Welding Handbook". During welding component parts shall be adequately clamped or supported. Avoid irregular surface, non-uniform bead pattern, and high crown. Upon completion of welding, remove weld splatter, flux, slag, and burrs. Accomplish repair, chipping, and grinding of welds in a manner that will not gouge, groove, or reduce the base metal thickness.
- H. Adhesive Anchors. Do not install anchors until the concrete has reached the required



28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. The hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions. Do not load the anchor until the adhesive has reached its indicated strength in accordance with the manufacturer's instructions.

- I. Wedge Anchors. Do not install anchors until the concrete has reached the required 28-day compressive strength. Drill hole in concrete by means of a percussion hammer drill. The hole shall be roughened with a brush on a power drill and then cleaned and dried. Install anchor in accordance with the manufacturer's instructions.
- J. Galvanizing Field Repairs:
  - 1. Surface preparation shall consist of removing oil, grease, soil, and soluble material by cleaning with water and detergent (SSPC SP1) followed by brush-off blast cleaning (SSPC SP7) over an area extending at least 4 inches into the undamaged area.
  - 2. The coating shall be applied to at least 3 mils dry film thickness and shall be **Zinc-Clad XI by Sherwin-Williams, Galvax by Alvin Products, Galvite by ZRC Worldwide**, or approved equal.

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**SECTION 06 10 00**  
**ROUGH CARPENTRY**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This Section covers the rough carpentry work which includes wood framing, plates, joists, rafters, purlins, wood trusses, blocking, furring, backing, nailers, plywood sheathing, siding, and similar elements, material, and accessories, complete and in place according to the Contract Drawings.

**1.2 RELATED WORK**

- A. Related work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures

**1.3 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN PLYWOOD ASSOCIATION (APA)
1. APA AFG-01 Adhesives for Field-Gluing Plywood to Wood Framing
  2. APA Form E30 Design/Construction Guide, Residential and Commercial
- C. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
1. AWPA M4 Standard for the Care of Preservative-Treated Wood Products
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 307 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 psi Tensile Strength
  2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  3. ASTM D 3498 Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
  4. ASTM F 1667 Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- E. AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)
1. AWPA U1-13 Use Category System: User Specification for Treated Wood
- F. NATIONAL FOREST PRODUCTS ASSOCIATION (NFOPA)
1. NFOPA-01 National Design Specification for Wood Construction
  2. NFOPA-02 Manual for Wood Frame Construction

#### G. TRUSS PLATE INSTITUTE (TPI)

1. TPI TPI-85            Design Specification for Metal Plate Connected Wood Trusses
2. TPI QST 88            Quality Standard for Metal Plate Connected Wood Trusses  
                         Addendum to TPI-85

#### H. WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

1. WWPA-01            Western Lumber Grading Rules

### 1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's catalogs showing rough hardware conforming to or equivalent to hardware indicated on the Contract Drawings.
- C. Structural and Miscellaneous Wood Members: Design analysis and calculations of fabricated wood trusses shall show design criteria used to accomplish the applicable analysis. Calculations and drawings shall be stamped by a Professional Engineer licensed in the State of Utah.
- D. Shop Drawings: Drawings of fabricated wood trusses shall indicate materials and shop and field erection details including methods of fastening.
- E. Manufacturer's Certificates: Manufacturer's certificates attesting that lumber and material not normally grade marked or exempt from being grade marked meets the specified requirements.

### 1.5 DELIVERY AND STORAGE

- A. Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity.

### 1.6 QUALITY ASSURANCE

- A. Materials and assembly shall be inspected to determine compliance with the Building Code.
- B. At completion of fabrication of the trusses, the fabricator shall submit a certificate of compliance to ENGINEER stating that the work was performed in accordance with the contract documents.

## PART 2 PRODUCTS

### 2.1 LUMBER AND SHEATHING

- A. Grading and Marking: Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included

in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade species used. Except for plywood and lumber, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

- B. Sizes: Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.
- C. Trussed Rafters: Rafters shall be a prefabricated design. Connections shall be made with light-metal plate-connectors. Light-metal-plate-connected wood trusses shall be designed in conformance with TPI TPI-85 and fabricated in conformance with TPI QST-88.
- D. Plywood: Plywood shall be APA performance rated, Grade C-D with exterior glue. Sheathing for roof without corner bracing of framing shall have a span rating of 16/0 or greater for supports 16 inches on center and a span rating of 24/0 or greater for supports 24 inches on center.
- E. Wood: Provide dressed lumber, S4S, unless otherwise indicated. Provide seasoned lumber with 19 percent maximum moisture. For structural framing use No. 2 grade Douglas-fir or Larch or any species or grade meeting the following requirements:
  - 1. Fb: 900 psi
  - 2. E: 1,600,000 psi

## 2.2 TRUSSES

- A. Marking: Each truss shall be marked or have permanently affixed thereto the following information near the center of the span on the bottom chord: truss manufacturer's name and address, design load, and spacing of the trusses.
- B. Connector plates shall be designed by the truss manufacturer in accordance with TPI Standards. Structural plates shall be structural quality steel and hot-dip galvanized according to ASTM A 653. Connector plates shall be provided on both sides of the truss, i.e. 2 plates per joint.

## 2.3 PRESERVATIVE TREATMENT

- A. The treatment of lumber, timber, and plywood shall meet the requirements of AWPB UC3B for above ground use only. All products shall bear the appropriate AWPB Quality Mark. The wood shall then be dried to the moisture content specified and marked with the word "Dry." Surfaces of lumber that will be exposed shall not be incised. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPB M4. Wood preservative shall be **Wolman AG by Arch Treatment Technologies, Preserve CA by Viance**, or approved equal. Unless otherwise specified the following items will always be treated:
  - 1. All wood members used in built-up roofing systems.

2. All wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
3. All wood members used for rough framing of openings in exterior concrete or masonry walls.
4. Nailing strips or nailers used in conjunction with roof systems.

## **2.4 ACCESSORIES AND NAILS**

- A. Anchor Bolts shall conform to ASTM A 307, size as indicated, complete with nuts and washers.
- B. Expansion Shields shall be the Type and size best suited for intended use.
- C. Joist Hangers and Truss Clips shall be steel or iron, zinc-coated, sized to fit members where used, sufficient strength to develop the full strength of supported member, complete with any special nails or bolts required. Framing devices shall be manufacturer by **Simpson Strong-Tie Company, Inc., USP Structural Connectors**, or approved equal.
- D. Nails and Staples shall be of the size and type best suited for the purpose and shall conform to the requirements of ASTM F 1667. For sheathing, the length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1-inch thick lumber and for toe nailing 2-inch thick lumber; 16-penny or larger nails shall be used for nailing through 2-inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION OF FRAMING AND MISCELLANEOUS WOOD MEMBERS**

- A. General: Members shall be closely fitted, accurately set to required lines and levels, and rigidly secured in place. Nailing shall be in accordance with the recommended Nailing Schedule as contained in NFOPA-02. Where detailed nailing requirements are not specified, nail size and nail spacing shall be sufficient to develop an adequate strength for the connection without splitting the members. Installation of timber connections shall conform to applicable requirements of NFOPA-01. Members shall be framed for passage of ducts and pipes shall be cut, notched, or bored in accordance with applicable requirements of NFOPA-02. Rafters, purlins, and joists shall be set with crown edge up. Leveling of joists, beams, and girders on masonry or concrete shall be with slate or steel; on wood or metal leveling shall be without shims.
- B. Cutting and Notching: Wood members shall not be cut, notched or bored more than 1/4 of their depth without adequate and approved reinforcing.
- C. Sill Plates: Sill plates shall be set level and square, and anchor bolted at not more than 2 feet 8 inches on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece. Sill plates and other wood resting on or embedded in concrete or masonry shall be pressure treated.

- D. Wall Framing: Wall studs shall be installed at a spacing of 16-inches on center unless otherwise indicated on the Contract Drawings. A single plate shall be provided at the bottom and a double plate at the top of wall framing unless noted otherwise. Joints in the top plates shall be staggered not less than 4 feet.
- E. Roof Framing or Rafters: Tops of supports or rafters shall form a true plane. Valley, ridge, and hip members shall be of depth equal to cut on rafters where practicable, but in no case less than depth of rafters. Valleys, hips, and ridges shall be straight and true intersections of roof planes. Necessary crickets and watersheds shall be formed. Rafters, except hip and valley rafters, shall be spiked to wall plate and to ceiling joists with no less than three 8-penny nails. Rafters shall be toe-nailed to ridge; valley, or hip members with at least three 8-penny nails. Rafters shall be braced to prevent movement until permanent bracing, decking or sheathing is installed. Hip and valley rafters shall be secured to wall plates by clip angles. Openings in roof shall be framed with headers and trimmers. Unless otherwise indicated, headers carrying more than two rafters and trimmers supporting headers carrying more than one rafter shall be double. Hip rafters longer than the available lumber shall be butt jointed and scabbed. Valley rafters longer than the available lumber shall be double, with pieces lapped not less than 4 feet and well spiked together. Trussed rafters shall be installed in accordance with TPI TPI-85.
- F. Blocking and Backing: Blocking and backing shall be nominal 2-inch thick material and shall be provided as necessary to meet the latest codes for lateral bracing and for application of siding, sheathing, subflooring, wallboard, and other materials or building items, and to provide fire stopping. Blocking and backing shall be cut to fit between framing members and rigidly nailed thereto.

### **3.2 INSTALLATION OF SHEATHING**

- A. Plywood: Sheathing shall be applied in accordance with APA standards and with edges 1/8 inch apart at side and end joints and nailed at supported edges at 6 inches on center and at intermediate supports 12 inches on center. Nailing of edges shall be 3/8 inch from the edges. Wall sheathing shall extend over top and bottom plates, and if applied horizontally the vertical joints shall be made over supports and staggered. Roof sheathing shall be applied with long dimension at right angles to supports, end joints made over supports, and end joints staggered.

### **3.3 INSTALLATION OF ROOF TRUSSES**

- A. CONTRACTOR shall be responsible for field erection of the trusses, including proper handling, safety precautions, temporary bracing to prevent toppling, and other safeguards which are consistent with good workmanship and building erection practices.
- B. CONTRACTOR shall comply with all applicable requirements and recommendations of TPI.
- C. CONTRACTOR shall not field repair, cut or otherwise alter trusses without consulting the truss manufacturer.

- END OF SECTION -

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**SECTION 07 11 00**  
**MOISTURE PROTECTION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section provides specifications for all waterproofing and damp proofing of the buried or below grade concrete surfaces, including moisture proof underlays for concrete slabs.

**1.2 RELATED WORK**

- A. Related Work in other sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures

**1.3 QUALITY ASSURANCE**

- A. Performance and Design Requirements. Prior to application of waterproofing, CONTRACTOR shall cause a representative of the manufacturer of the materials to inspect and certify that the surfaces to be waterproofed are in a condition suitable for application of the waterproofing. Following application of the waterproofing, CONTRACTOR shall cause a representative of the manufacturer of the materials to inspect and certify that the materials were applied in complete accordance with the manufacturer's current recommendations.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM D 450 Standard Specification for Coal-Tar Pitch Use in Roofing, Dampproofing, and Waterproofing
  - 2. ASTM D 882 Test Method for Tensile Properties of Thin Plastic Sheet
  - 3. ASTM D 1668 Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing.
  - 4. ASTM E 1643 Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slab
  - 5. ASTM F 1249 Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheet Using a Modulated Infrared Sensor
- C. PRESSURE SENSITIVE TAPE COUNCIL (PSTC)
  - 1. PSTC 101 International Standard for Peel Adhesion of Pressure-Sensitive Tape

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer product data, cut sheets, and recommended installation instructions.

- C. Prior to acceptance of the work, CONTRACTOR shall deliver to ENGINEER two copies of the specified certifications for material application.

## **PART 2 PRODUCTS**

### **2.1 WATERPROOF COATING**

- A. Waterproof coating shall be coal tar epoxy resin. Acceptable products are **Bitumastic 300M by Carboline, Targuard Low VOC Coal Tar Epoxy by Sherwin Williamns, PorterTuf 2000 HB Coal Tar Epoxy by Porter Coating, Series 46H-413 HB Tneme-Tar by Tnemec, Amercoat 78HB by PPG Protective & Marine Coatings**, or approved equal.

### **2.2 MOISTUREPROOF COATING**

- A. Moistureproof coating shall be coal tar solution. Acceptable products are **Bitumastic 50 by Carboline, Corothane I Coal Tar by Sherwin Williams, Series 46-465 HB Tnemecol by Tnemec, HE107 by Henry**, or approved equal.

### **2.3 DAMPPROOFING MEMBRANE SYSTEM**

- A. Provide and install a membrane system with two coats of emulsion, reinforcing fabric, and protection board.
- B. Spray-on or Brush-on Grade: asphalt-based, clay emulsion with fibers meeting the requirements of ASTM D1227, Type II, Class 1.
- C. Trowel-on Grade: trowel applied mineral colloid, asphalt emulsion, fibrated with selected fibers and produced in an ideal, light trowel application consistency meeting the requirements of ASTM D1227, Type II, Class 1.
- D. VOC Content: <45 g/L
- E. The manufacturer shall be **W.R. Meadows Sealmastic, Master Builders Masterseal 614 or 615, Henry 789 or 785**, or approved equal.
- F. Membrane Reinforcing Fabric: spun-bonded polyester hot/cold reinforcing fabric. The manufacturer shall be **W.R. Meadows Fabric HCR, Master Builders Masterseal 995, Henry Polyester Fabric**, or approved equal.
- G. Reglets: Reglets for anchoring membrane shall be fabricated of plastic.
- H. Protective Board: a multi-ply, semi-rigid core composed of a mineral-fortified asphalt core formed between two outside layers of asphalt impregnated reinforced mats, manufactured in accordance with ASTM D 6506. Protective board shall be nominal 0.25-inch thick (5.6 to 7.1 mm). The manufacturer shall be **WR Meadows PC-3 Protection Board** or approved equal.

### **2.4 MOISTUREPROOF UNDERLAY**

- A. Plastic Membrane. Plastic membrane for moistureproof underlay shall be an ASTM E 1745 Class A membrane manufactured from virgin polyolefin resins having a minimum film thickness of 10 mils. Plastic membrane shall meet the following specifications:

1. Water Vapor Permeance: 0.05 perms maximum (perm unit = grains/(ft<sup>2</sup>\*hr\*in-Hg)) in accordance with ASTM F 1249.
  2. Tensile Strength: 50 lbf/in (minimum) per ASTM D 882.
- B. Acceptable membranes are **Stego Wrap Class A by Stego Industries, Perminator by W. R. Meadows, Vapor Barrier Blue VB10 by Americover**, or approved equal.
- C. Pressure Sensitive Tape. Pressure sensitive tape shall be minimum 3-inch wide, 6 mil pressure sensitive polyethylene tape with acrylic, pressure-sensitive adhesive. Manufacturers shall be **Stego Tape by Stego Industries, Perminator Tape by W.R. Meadows, VTW Vapor Tape by Americover**, or approved equal.

## **PART 3 EXECUTION**

### **3.1 WATERPROOF COATING**

- A. Location. Waterproof coating shall be applied to the water side of walls and bottoms of channels or tanks which are common with areas to be occupied by equipment, piping or personnel. Waterproof coating shall not be applied to those surfaces to receive liquid waterproofing.
- B. Surface Preparation. New concrete to be waterproofed shall have aged at least 60 days and shall have a moisture content of less than 14%. Concrete surface shall be brush treated with a 10% muriatic acid solution and thoroughly flushed with water after 10 minutes.
- C. Walls of existing channels and tanks shall be steam cleaned prior to application of waterproofing material.
- D. Application. Prime coat shall be thinned and applied at the rate of approximately 200-300 square feet per gallon depending on surface condition. Finish coats shall be applied at the rate of 100 square feet per gallon. Final coat shall be black. Total dry film thickness shall be minimum 20 mils. Drying time between coats shall be as recommended by the paint manufacturer.
- E. Application Procedures. Following the manufacturer's application instructions and these application procedures for waterproofing products as listed in paragraph 2.1 are as follows:
1. Prime coat shall consist of one coat of coal tar epoxy resin coating, black. Finish coats shall consist of two coats of coal tar epoxy resin coating, alternating red and black colors.

### **3.2 MOISTUREPROOF COATING**

- A. Location. Moistureproof coating shall be applied to below grade, earth side of outside concrete walls which are common with areas to be occupied by equipment, piping, or personnel. Moistureproof coating is not required for walls to be provided with waterproof membrane or for walls which are poured directly against an excavated surface.
- B. Surface Preparation. Preparation of concrete and masonry walls shall conform to manufacturer's recommendations.

- C. Application. Prime and finish coats shall be applied at the rate of 70 square feet per gallon. The number of finish coats shall be sufficient to produce a dry film thickness of at least 13 mils. Drying time between coats shall be as recommended by the paint manufacturer.

### **3.3 WATERPROOF MEMBRANE**

- A. Location. Waterproof membrane shall be applied to exterior surfaces as designated on the drawings.
- B. Surface Preparation. Concrete surfaces to receive waterproof membrane shall be clean, dry and shall have at least a Class II form finish.

### **3.4 MOISTUREPROOF UNDERLAY**

- A. Install moistureproof underlay in accordance with the manufacturer's written installation instructions.
- B. Location. Unless otherwise noted, moistureproof underlay shall be provided under all concrete floors or floating slabs-on-grade deposited on gravel base or sand. Moistureproof underlay shall be provided under all concrete floors or floating slabs-on-grade with pressure relief valves and gravel base.
- C. Surface Preparation. Backfilled surfaces to receive moistureproof underlay shall be leveled off and smoothed over to minimize contact with sharp edges. Joints shall be sealed by means of pressure sensitive tape. Where pipes and conduits pass through the plastic membrane, they shall be wrapped tightly with separate sheets of membrane which shall then be sealed with tape to the main membrane. Reinforcing steel or mesh shall be supported by small precast placing chairs designed with flat bases to protect the membrane. CONTRACTOR shall exercise care to maintain the integrity of the membrane at all times.

- END OF SECTION -

**SECTION 07 21 00**  
**INSULATION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section covers the work required to provide and install insulation in buildings and structures, complete and in place.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 04 22 00 Reinforced Unit Masonry

**1.3 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM C 272 Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions
  2. ASTM C 518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
  3. ASTM C 547 Standard Specification for Mineral Fiber Pipe Insulation
  4. ASTM C 549 Standard Specification for Perlite Loose Fill Insulation
  5. ASTM C 553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
  6. ASTM C 578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
  7. ASTM C 592 Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
  8. ASTM C 612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
  9. ASTM C 665 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
  10. ASTM C 1029 Standard Specification for Spray-Applied Rigid Cellular Polyurethane Thermal Insulation
  11. ASTM D 1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
  12. ASTM D 1621 Standard Test Method for Compressive Properties of Rigid Cellular Plastics
  13. ASTM D 2842 Standard Test Method for Water Absorption of Rigid Cellular Plastics

- 14. ASTM E 84            Standard Test Method for Surface Burning Characteristics of Building Materials
- 15. ASTM E 96           Standard Test Methods for Water Vapor Transmission of Materials

C. UNDERWRITERS LABORATORIES (UL)

- 1. UL1256    Fire Test of Rook Deck Constructions

D. FACTORY MUTUAL (FM)

- 1. Approval Standard for Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems

#### **1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's literature, installation instructions, product test reports and technical data.
- C. Submit manufacturer's certification that the proposed materials comply with this Section.
- D. For foam-in-place insulation, submit a copy of the foam insulation contractor's certification and ICC-ES report and manufacturer's documentation confirming material conforms to ASTM C 1029.

#### **1.5 DELIVERY AND STORAGE**

- A. Materials shall not be allowed to become wet, soiled, or covered with ice and snow. Manufacturer's recommendations for handling storage and protection shall be strictly followed. If required, during cold weather, store in heated storage areas following the manufacturer's guidelines for minimum and maximum temperatures. Material shall not be exposed to sunlight and shall be protected against ignition. Materials shall be concealed as quickly as possible after completion of work.

### **PART 2 PRODUCTS**

#### **2.1 INSULATION**

- A. Thermal resistance of insulation shall be not less than the R-values shown on the Contract Drawings. R-values shall be determined at 75 degrees F in accordance with ASTM C 518. Insulation shall be the standard product of a manufacturer and factory marked or identified with manufacturer's name or trademark and R-value. Identification shall be on individual pieces or individual packages.
- B. The materials and application of building insulation shall conform to the applicable requirement of the Underwriters Laboratories "Fire Resistance Index", Factory Mutual requirements, and the manufacturer's recommendations.
- C. Minimum R-Value in all roof insulation shall be R-30.

## 2.2 FOAMED-IN-PLACE THERMAL INSULATION

- A. Foamed-in-place or sprayed polyurethane foam plastic insulation conforming to the requirements of ASTM C 1029 shall be placed in cavities of masonry walls. Foamed-in-place thermal insulation in walls shall be 2-component cellular plastic insulation comprised of a spray-dried polymeric resin and a foaming catalyst concentrate insulation by frothing/pouring in place. It shall have the following characteristics:

Property	Requirement	Standard
Core Density	0.5-1.0 pcf	ASTM D 1622
Thermal Resistance at 140°F/90 day Aged R Value, at 75°F mean Temp, min	R4.6/inch	ASTM C 518

- B. Foamed-in-place insulation shall be **InsulSmart Interior Foam Insulation by CFI FOAM, Inc., Core-Fill 500 by Tailored Chemical Products**, or approved equal.

## 2.3 CMU BLOCK INSULATION INSERTS

- A. As an alternative to Foamed-in-Place Thermal Insulation, CMU Block Insulation Inserts may be installed. Inserts shall be flame retardant, expandable polystyrene design specifically to fit inside standard two (2) core masonry units. Inserts shall meet the requirements of ASTM C 578 with minimum density of 1.25 pcf. Inserts shall meet the following characteristics:

Property	Requirement	Standard
Thermal Resistance (R) per inch at 75°F (minimum)	4.1	ASTM C 518
Water Vapor Permeance per inch of thickness (minimum)	1.1	ASTM C 355 or ASTM E 96
Water Absorption Percent (%) by Volume (maximum)	1.8	ASTM C 272

- B. CMU Block Insulation Inserts shall be **ThermaSound CMU Block Insert, Korfil by Concrete Block Insulating Systems (DRIS)**, or approved equal.

## 2.4 BLANKET INSULATION

- A. Blanket insulation shall be glass or other inorganic fibers and resinous binders formed into flexible blankets complying with ASTM C 665, Type III, with foiled back vapor barrier laminated to one face, with 1-inch flanges on long edges, and vapor transmission not more than 0.50 perms. Manufacturers shall be **Owens-Corning, CertainTeed, Johns-Manville**, or approved equal.

## 2.5 EXTRUDED POLYSTYRENE BOARD (RIGID) INSULATION

- A. Rigid insulation shall be polystyrene conforming to ASTM C 578, Type IV with surface burning characteristics per ASTM E84 maximum of 5 for flame-spread and 175 for smoke developed. Minimum thermal resistance per inch of R-5.0 per ASTM C 518 at 75°F mean temperature. Minimum compressive strength of 25 psi per ASTM D 1621.

- B. Insulation for roof decks shall be listed per UL 1256 and shall be in compliance with FM Class I roof decks.
- C. Insulation thickness in interior walls shall be 4 inches.
- D. Manufacturers shall be **Dow Chemical, Owens Corning**, or approved equal.
- E. Sill Sealer: Mineral wool, 1 inch thick and compressible to 1/32-inch, width of sill, designed to perform as an air, dirt, and insect seal.

## **2.6 ALUMINUM SHEETING WITH RIGID INSULATION**

- A. Vaults with electric power shall be insulated with a combination of rigid insulation (see 2.4) and 24-mil thick (min) aluminum sheeting coated flat white.
- B. Accessories:
  - 1. Adhesive: As recommended by manufacturer. Adhesive shall be formulated specifically to bond insulation to steel (hatches and panels) and to concrete surfaces.
  - 2. Tape: Aluminum foil tape with facing to match rigid insulation as recommended by the manufacturer.
  - 3. J-Channel: PVC Closure strip as recommended by manufacturer for terminations.
  - 4. Clip Strip: PVC closure strip for vertical and horizontal seams.
  - 5. Fasteners: **Hilti Insulation Fasteners (IZ-type)**, or approved equal.
- C. Aluminum Sheet Manufacturer: **Insul-Mate by RPR Products, Inc.**, or approved equal.

## **2.7 EXTRUDED POLYSTYRENE BOARD (RIGID) INSULATION (BURIED LOCATIONS)**

- A. Rigid insulation for buried locations shall be polystyrene conforming to ASTM C 578, Type IV with surface burning characteristics per ASTM E84 maximum of 75 for flame-spread and maximum of 450 for smoke-developed. Minimum thermal resistance per inch of R-5.0 per ASTM C 518 at 75°F mean temperature. Minimum compressive strength of 25 psi per ASTM D 1621.
- B. Insulation thickness for exterior foundation walls shall be 1.5 inches minimum.
- C. Manufacturers shall be **Dow Chemical, Owens Corning**, or approved equal.
- D. Sill Sealer: Mineral wool, 1 inch thick and compressible to 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal.



## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Verify substrate and adjacent materials and insulation board are dry and ready to receive adhesive.
- B. Verify mechanical and electrical services within walls have been installed and tested.

### **3.2 INSTALLATION OF INSULATION**

- A. Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. For thermal insulation the actual installed thickness shall provide the R-values shown. For acoustical insulation the installed thickness shall be as shown. Insulation shall be installed on the weather side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

### **3.3 INSTALLATION OF FOAMED-IN-PLACE THERMAL INSULATION**

- A. The polyurethane foam shall be placed in 4-foot lifts. All insulation shall be done in close coordination with the masonry contractor to allow quality control.
- B. The polyurethane foam shall be applied by qualified firms with proper dispensing equipment.
- C. Apply in accordance with ASTM C 1029 guidelines and the manufacturer's instructions.

### **3.4 INSTALLATION - RIGID INSULATION**

- A. Foundation Perimeter:
  - 1. Adhere a 6 inches wide strip of polyethylene sheet over joints with double beads of adhesive each side of the joint. Tape seal joints between sheets. Extend sheet full height of joint.
  - 2. Install boards on foundation wall perimeter, horizontally. Place boards in a method to maximize contact bedding. Stagger end joints. Butt edges and ends tight to adjacent board and to protrusions.
  - 3. Extend boards over expansion joints, unbonded to foundation 12 inches either side of joint.
- B. Exterior Walls:
  - 1. Apply adhesive in 3 continuous beads per board length. Daub adhesive tight to protrusions.
  - 2. Install boards on wall surface perimeter, vertically. Place membrane surface of insulation against adhesive.
  - 3. Place boards in a method to maximize contact bedding. Stagger side joints. Butt edges and ends tight to adjacent board and to protrusions.
  - 4. Place 24" side polyethylene sheet at perimeter of wall openings from adhesive vapor and air retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor and air retarder.

C. Cavity Walls:

1. Secure impane fasteners to substrate at a frequency of 6 per insulated board.
2. Apply adhesive in 3 continuous beads per board length. Daub adhesive tight to protrusions to ensure continuity of vapor and air retarder.
3. Install boards horizontally between wall reinforcement.

D. Under Concrete Slabs:

1. Place insulation under slabs on grade after base for slab has been compacted.
2. Prevent insulation from being displaced or damaged while placing vapor retarder and placing concrete slab.

**3.5 INSTALLATION - BATT INSULATION**

- A. Install batt insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install batt insulation without gaps or voids
- C. Trim insulation neatly to fit spaces. Use batts free of damage.
- D. Fit insulation tight in spaces airtight to exterior side of mechanical and electrical services within the plane of insulation.
- E. Protect all insulation materials during storage and insulation from moisture, tears, or other damage. All damaged material shall be replaced at no additional cost to OWNER.

- END OF SECTION -

**SECTION 07 32 00**  
**METAL ROOFING SYSTEMS**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall furnish and install metal roofing and soffit panels, system support framing, and appurtenant work, complete and in place. Provide and install a 2-inch standing seam, concealed fastener metal roofing system.
- B. The principal items of sheet metal work included in the metal roofing system shall include sheet metal flashing, covers, trim, enclosure batts, collars and sleeves at all roof penetrations, metal soffit panels, and all other sheet metal items necessary for a complete and watertight metal roofing system.
- C. The metal roofing applicator shall coordinate his work with sheet metal gutter work and shall report to CONTRACTOR and ENGINEER if any sheet metal work provided by others affects his work negatively.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 07 62 00 Sheet Metal Flashing and Trim

**1.3 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  - 2. ASTM A 924 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
  - 3. ASTM D 226 Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
  - 4. ASTM D 412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension
  - 5. ASTM D 903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds
  - 6. ASTM D 1938 Standard Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method
  - 7. ASTM D 1970 Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
  - 8. ASTM D 3767 Standard Practice for Rubber—Measurement of Dimensions
  - 9. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials

- 10. ASTM E 330      Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- 11. ASTM E 1646      Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
- 12. ASTM E 1680      Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems

C. UNDERWRITERS LABORATORY (UL)

- 1. UL 580      Test for Uplift Resistance of Prepared Roof Assemblies

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit detailed shop drawings showing materials, gages, finishes, layout, corners, trim, flashing, enclosures, edge conditions, jointing, profiles, supports, fasteners, fabrication of special shapes, and method of attachment to adjacent construction to Engineer prior to fabrication. Submit drawings indicating roof size, location and type of penetrations, perimeter and penetration details, roof insulation make-up and sheet layout that have been accepted by an authorized manufacturer's representative.
- C. Submit manufacturer's literature indicating materials, finish, construction, and method of installation of prefabricated items and sealant.
- D. Provide color samples for color selection by OWNER.
- E. Submit the following test reports, certified by an Independent Testing Laboratory or a professional engineer registered in the State of Utah to verify the proposed roofing will meet performance requirements of this Specification:
  - 1. Thermal Cycle Test
  - 2. ASTM E 330 Adapted to Test Formed Metal Panels
  - 3. Clip Fastener Pull-Out Tests and Calculations
  - 4. UL 580 Class 90
  - 5. Concentrated Load Test Data
  - 6. Air Infiltration and Water Penetration Test Results
  - 7. Coating Performance Testing
- F. Submit certification by the manufacturer that the roofing assembly is listed in the UL Building Materials Directory with a Class 1-90 wind uplift rating, including relevant construction number.

**1.5 WARRANTIES**

- A. Manufacturer shall provide to OWNER written warranty that the roof panels will not rupture, fail structurally, or perforate due to corrosion for a period of 20 years from the date of installation.
- B. Roofing manufacturer shall provide written 10-year material and labor warranty beginning at the date of final acceptance.

- C. CONTRACTOR shall provide to OWNER written warranty that the roof system is installed in accordance with the manufacturer's recommendations and will be free from defective workmanship and remain watertight and weatherproof with normal usage for two (2) years following Project Substantial Completion date.

## 1.6 QUALITY ASSURANCE

- A. A single installer shall perform the work of this Section and shall have completed projects of similar scope and complexity.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Subject to compliance with the requirements, manufacturers who may offer metal roofing systems and products, which may be incorporated into the work, include **AEP Span Span-Lok hp, Fabral Powerseam II, Holcim Elevate UC-6**, or approved equal.

### 2.2 ROOF PANELS

- A. Minimum Performance Ratings and Properties:

1. Air infiltration: Panel shall have less than 0.01 cfm/sf air infiltration at  $\pm 6.24$  psf pressure differential when tested in accordance with ASTM E 1680.
2. Water penetration: Panel shall have no leakage through panel joints when tested in accordance with ASTM E 1646 at static pressure differential of 12.0 psf.
3. Provide UL90 rated roofing system that has been tested in accordance with UL 580 test procedure.

- B. Profile:

1. Roof panels shall be factory formed ribbed seam pattern with 2-inch high seams and a nominal panel width of 16-inches. Panel surface shall be smooth.
2. Soffit panels shall be 12-inches wide, 1-1/2" deep, 22- gauge, AZ50 Galvalume steel, with concealed fastener, lock-joint design and shall be continuous-vented.

- C. Length:

1. Provide panels of sufficient length to minimize end laps.

- D. Profile Composition:

1. Base metal shall be a minimum 24-gage structural steel (minimum yield strength 50,000 psi) with AZ50 Galvalume hot dipped galvanized coating conforming to ASTM A 653.
2. Sheet metal trim, flashing, and accessories shall be the same material, gauge, finish, and color as the metal roofing.
3. Paint Finish:
  - a. All panels shall receive a factory applied Kynar 500/Hylar 5000 finish applied to both sides of the panel over the base protective coating, or approved equal. The exposed side coating shall have a minimum total dry film thickness of 1.0 mil and the underside coating shall have a minimum total dry film thickness of 0.5 mil. Color to be as determined by OWNER.

E. Concealed-Clips:

1. Material: 18-gauge steel with class G60 galvanized coating.
2. Configuration: clips shall be designed so as to attach with two concealed fasteners, and fully attach two ribs of every panel.
3. Spacing: In accordance with the manufacturer's recommendations.

Fasteners: Self-drilling or self-tapping galvanized steel screws and/or stainless-steel pop rivets painted to match the panels where visible, per the panel manufacturer's recommendations.

- F. Sealants: Sealants shall not contain oil, asbestos, or asphalt. Factory applied sealant shall be applied in the seam and designed for metal to metal concealed joints. Field applied panel end sealant shall be mastic tape sealant. Exposed sealant shall be one-part polyurethane joint sealant. All sealants used shall be as recommended by the metal roofing manufacturer for the job conditions and warranty requirements.
- G. Leak Barrier (Water and Ice Shield) shall be a cold applied, self-adhering membrane composed of high strength polyethylene film coated with a layer of rubberized asphalt adhesive and interwound with a disposable release sheet designed for use with metal roofing systems. An embossed lip resistant surface shall be provided on the polyethylene. Underlayment shall be UL 790 (ASTM E 108) listed Class A fire classification and meet the requirements of Table 07 32 00-1. Leak Barrier shall be **Ice and Water Shield HT by Grace Construction Products**, or approved equal.

Table 07 32 00-1		
Property	Value	Test Method
Color	Gray-Black	
Thickness	40 mil	ASTM D 3767 method A
Tensile Strength	MD 25 lbf/in CD 25 lbf/in	ASTM D 412 (Die C modified)
Elongation	250%	ASTM D 412 (Die C modified)
Low Temperature Flexibility	Unaffected @ -20°F	ASTM D 1970
Adhesion to Plywood	3.0 lbs/in width	ASTM D 903
Permeance (maximum)	0.05 Perms	ASTM E 96

- H. Weather resistive barrier: Membrane underlayment shall be composed of a high-strength, spun-bonded polypropylene base sheet, co-extruded on both sides with UV stabilized polyolefin, weight 30-pound. Membrane underlayment shall conform to ASTM D 226, Type II. Permeability shall be 0.54 perms maximum in accordance with ASTM E 96, Procedure A, and tear strength shall be minimum 20 pounds in accordance with ASTM D 1938. Membrane underlayment shall be **Grace Tri-Flex 30 by Grace Construction Products**, or approved equal.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Verify proper placement of all roof openings, pipes, curbs, sleeves, ducts, vents and drains.

### **3.2 SUBSTRATE PREPARATION**

- A. Comply with manufacturer's instructions for preparation of substrate to receive roofing. Clean substrate of dust, debris and other substances detrimental to the roofing work.

### **3.3 NAILERS**

- A. Install treated wood nailers at roof perimeters, at base of roof projections, and around specified roof penetrations.
  - 1. Total nailer height shall match total thickness of insulation being used. Install with 1/8" gap between each length and at changes in direction.
  - 2. Firmly fasten nailer to the deck, wall, or existing structurally sound and secured nailer at (16") o.c. maximum, so as to resist a force of 200 pounds per lineal foot in any direction.
  - 3. Taper nailer where applicable to be flush at point of contact with membrane in either the vertical or horizontal applications.

### **3.4 GENERAL**

- A. The metal roofing shall be installed by an applicator and fabricator approved by the roofing system manufacturer who has working experience with the roofing system. Contractor shall provide a letter signed by the roofing manufacturer that the installer is an approved applicator and fabricator of the roofing system.
- B. The metal roofing systems shall be installed in accordance with the manufacturer's instructions and recommendations applicable to the job conditions and supporting substrates.
- C. The panels and other components of the system shall be securely anchored and placed with concealed fasteners and shall be provided with provisions for thermal/structural movement.
- D. Shim and align panel units within installed tolerances of 1/4-inch in 20 feet on level/plumb/slope and location/line as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
- E. Joint sealers shall be furnished and installed where necessary or where required for weatherproofing of the system.

### **3.5 INSTALLATION OF UNDERLAYMENT**

- A. General: Install underlayment using methods recommended by the manufacturer and in accordance with local building codes. When local codes and application instructions are in conflict, the more stringent shall take precedence.
- B. Eaves: Install eaves with metal flashing tight with fascia boards. Lap joints 2 inches and seal with plastic cement or high-quality urethane sealant. Nail at the top of the flange. Install leak barrier up slope from eaves edge a full 36 inches or to at least 24 inches beyond the interior "warm wall". Lap ends of leak barrier at least 6 inches.
- C. Valleys: Install leak barrier at least 36 inches wide and centered on the valley. Lap ends at least 6 inches.

- D. Hips and Ridges: Install leak barrier along entire lengths. If ridge vents are to be installed, position leak barrier so that the ridge slots will not be covered.
- E. Roof Deck: Install a layer of roof underlayment over the entire area not protected by leak barrier. Install sheets horizontally so water sheds and nail in place. On roofs sloped more than 4:12 lap horizontal edges at least 2 inches and at least 2 inches over leak barrier. For roofs sloped between 2:12 and 4:12, lap horizontal edges at least 19 inches and at least 19 inches over leak barrier. Lap ends at least 4 inches and stagger ends laps at least 36 inches. Lap roof underlayment at least 6 inches over leak barrier in valley.
- F. Penetrations:
  - 1. Vent Pipes: Install a 24-inch square piece of leak barrier lapping over roof underlayment and seal tightly to pipe.
  - 2. Skylights or Access Hatches: Install leak barrier membrane extending at least 6 inches up the wall and 12 inches on to the roof surface. Lap the membrane over the roof deck underlayment.

### **3.6 INSTALLATION**

- A. Metal panels shall be installed in accordance with the approved shop drawings and the manufacturer's recommendations.
- B. Remove any strippable protective coating on the panels and flashings prior to installation and in any case do not allow the strippable coating to remain on the panels in extreme heat, cold, or in direct sunlight or other UV source.
- C. Loosely lay roof insulation with end joints staggered. (Stagger joints between layers.) Joints shall be 1/4-inch or less in width. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered the same day with membrane and completed.

### **3.7 CLEANING AND PROTECTION**

- A. Panels and other components of the work which have been damaged or have deteriorated beyond successful repair by means of finish touch-ups or similar minor repair procedures, shall be removed, and replaced at no cost to OWNER.
- B. Temporary protective coverings and strippable films shall be removed from the materials during installation. Upon completion of the work, the roofing systems shall be cleaned as recommended by the roofing manufacturer and shall be maintained in a clean condition until acceptance of the Work by OWNER.

- END OF SECTION -



**SECTION 07 62 00**  
**SHEET METAL FLASHING AND TRIM**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall provide and install sheet metal flashing and trim, and appurtenant work, complete in place, in accordance with the Contract Documents.

**1.2 RELATED DOCUMENTS**

- A. Related work in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 06 10 00 Rough Carpentry
  3. Section 07 32 00 Metal Roofing Systems
  4. Section 07 92 00 Joint Sealants

**1.3 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
  3. ASTM A 792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
  4. ASTM C 920 Standard Specification for Elastomeric Joint Sealants.
  5. ASTM C 1311 Standard Specification for Solvent Release Sealants.
  6. ASTM D 1187 Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
  7. ASTM D 4586 Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- C. Sheet Metal and Air Conditioning Contractors Association, SMACNA - Architectural Sheet Metal Manual

**1.4 PERFORMANCE REQUIREMENTS**

- A. Materials, anchorage, fastenings, and workmanship shall qualify for UL Class 115 MPH (3 second gust) wind uplift rating.
- B. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- C. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation,

overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and night time-sky heat loss.

1. Temperature Change (Range): 120° F, ambient; 180° F, material surfaces.

D. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

## **1.5 SUBMITTALS**

A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.
4. Details of expansion-joint covers, including showing direction of expansion and contraction.

C. Submit manufacturer's specifications, literature, and published installation and maintenance instructions for all sheet metal products.

D. Provide samples of color where required.

## **1.6 QUALITY ASSURANCE**

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

## **1.8 COORDINATION**

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leak-proof, secure, and noncorrosive installation.

## **PART 2 MATERIALS**

### **2.1 SHEET METAL**

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, AZ50 Galvalume coating designation; structural quality.
  - 1. Thickness 0.0239-inch (24 U.S. Standard gauge), unless shown otherwise.
  - 2. Finish-factory applied to match color of metal frames, or trim.
- B. Manufacturers shall be **Cheney Flashing Company, Fry Reglet Corporation, Heckmann Building Products, Inc.**, or approved equal.

### **2.2 DOWNSPOUTS, GUTTER AND TRIM**

- A. Downspouts, gutters, and trim shall be same metal and thickness as roof panels. Fabricate gutters in minimum 96-inch long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from the same material as gutters. Fabricate expansion joints, expansion joints covers, gutter bead reinforcing bars, and gutter accessories from same material as gutters. Shop fabricate interior and exterior corners.
- B. Color shall match roof panels.

### **2.3 FASCIA AND RAKE TRIM**

- A. Fascia and rake trim shall be same metal and thickness as roof panels.
- B. Color shall match roof panels.

### **2.4 MISCELLANEOUS MATERIALS**

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.
- B. Fasteners: Self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.
  - 1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating. Steel, galvanized per ASTM A153/A153M or stainless steel.
  - 2. Fasteners for Flashing and Trim: Steel, galvanized per ASTM A153/A153M or stainless steel. Blind fasteners or self-drilling screws, gasketed, with hex washer head.
  - 3. Blind Fasteners: High-strength stainless-steel rivets.
- C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanent elastic, non-sag, nontoxic, non-staining tape.

- D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.
- F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## **2.5 FABRICATION, GENERAL**

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
- C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
  - 1. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flatlock seams. Tin edges to be seamed, form seams, and solder.
- D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.
- F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
  - 1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.
- H. Reinforcement and Supports: Provide same material as flashing, unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.
- I. Rigid Joints and Seams: make mechanically strong. Solder galvanized and stainless-steel metal joints. Do not use solder to transmit stress.
- J. Provide watertight closures at exposed ends of counterflashing.

## **2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS**

- A. Counterflashing: Fabricate from the following material:
  - 1. Galvanized Steel: 0.022-inch thick.
- B. Roof-Penetration Flashing: Fabricate from the following material:
  - 1. Galvanized Steel: 0.028-inch thick.

## **2.7 DOWNSPOUTS AND GUTTERS FABRICATION**

- A. Form downspouts and gutters in maximum lengths as practicable to sizes and shapes indicated on the Contract Drawings.
  - 1. Lock longitudinal joints of downspouts.
  - 2. Telescope end joints 1-1/2 inches.
  - 3. Provide elbows at bottom where downspouts discharge onto splash blocks.
  - 4. Anchor downspouts with straps of same material as downspouts.
  - 5. Install gutters at locations indicated on drawings.

## **2.8 MISCELLANEOUS SHEET METAL FABRICATIONS**

- A. Equipment Support Flashing: Fabricate from the following material:
  - 1. Galvanized Steel: 0.028-inch thick.

## **2.9 FLEXIBLE BASE PIPE SEALS**

- A. Flexible base pipe seals shall be prefabricated on-piece aluminum flanged base with stepped, graduated EPDM profile which creates a compression seal between the piping and the flashing. Aluminum base shall be flexible to conform to profile of roof panels.
- B. Manufacturers and Products, or approved equal:
  - 1. Pate Co.; Dektite.
  - 2. Portals Plus, Inc.; Deck-Mate.
- C. Coat aluminum surfaces in contact with dissimilar metals in accordance with 3.2.B of this Section.
- D. Isolation tape shall be butyl or polyisobutylene, internally reinforced.
- E. Fasteners shall be stainless steel of type required.

## **2.10 FINISHES**

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.
  - 1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
  - 2. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION, GENERAL**

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
  - 1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
  - 2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.
  - 3. Use only stainless-steel fasteners to connect isolated dissimilar metals.
- C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.
- E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
- F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 30 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing

hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

- G. Seal joints with elastomeric sealant as required for watertight construction.
  - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70° F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40° F.
  - 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 - "Joint Sealants."
- H. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
  - 1. Pretinning is not required for lead-coated copper.
  - 2. Where surfaces to be soldered are lead coated, do not tin edges, but wire brush lead coating before soldering.
  - 3. Lead-Coated Copper Soldering: Wire brush edges of sheets before soldering.
  - 4. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

### **3.3 ROOF FLASHING INSTALLATION**

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
- B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with elastomeric sealant.
  - 1. Secure in a waterproof manner by means of anchor and washer at 36-inch centers, or other method approved by ENGINEER.
- D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
  - 1. Use appropriate flexible base pipe seal where pipe, conduit or cable, etc. penetrate roofing system.

2. Make work watertight and free of expansion and contraction noise. Seal and clamp flashing to pipes penetrating roof.

### **3.4 CLEANING AND PROTECTION**

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder and sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

-END OF SECTION -



**SECTION 07 92 00**  
**JOINT SEALANTS**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES:**

- A. Polyurethane Sealants
- B. Tape Mastic Sealants
- C. Silicone Sealants

**1.2 RELATED DOCUMENTS**

- A. Related Work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures

**1.3 REFERENCES**

- A. The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN ARCHITECTURAL MANUFACTURER'S ASSOCIATION (AAMA)
  - 1. AAMA 800-10 Voluntary Specifications and Test Methods for Sealants
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 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 792 Standard Specification for Steel Sheet, 55 % Aluminum-Zinc Alloy Coated by the Hot-Dip Process.
  - 3. ASTM C 639 Standard Test Method for Rheological (Flow) Properties of Elastomeric Sealants
  - 4. ASTM C 661 Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer
  - 5. ASTM C 681 Standard Test Method for Volatility of Oil- and Resin-Based, Knife Grade, Channel Glazing Compounds
  - 6. ASTM C 711 Standard Test Method for Low-Temperature Flexibility and Tenacity of One-Part, Elastomeric, Solvent-Release Type Sealants
  - 7. ASTM C 794 Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
  - 8. ASTM C 834 Standard Specification for Latex Sealants
  - 9. ASTM C 908 Standard Test Method for Yield Strength of Preformed Tape Sealants
  - 10. ASTM C 920 Standard Specification for Elastomeric Joint Sealants
  - 11. ASTM D 56 Standard Test Method for Flash Point by Tag Closed Cup Tester
  - 12. ASTM D 217 Standard Test Methods for Cone Penetration of Lubricating Grease

- |                 |   |
|-----------------|---|
| 13. ASTM D 412  | Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension                                      |
| 14. ASTM D 792  | Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement                   |
| 15. ASTM D 925  | Standard Test Methods for Rubber Property—Staining of Surfaces (Contact, Migration, and Diffusion)                      |
| 16. ASTM D 2452 | Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds  |
| 17. ASTM D 2453 | Standard Test Method for Shrinkage and Tenacity of Oil- and Resin Base Caulking Compounds                               |
| 18. ASTM D 1475 | Standard Test Method For Density of Liquid Coatings, Inks, and Related Products   |
| 19. ASTM D 2202 | Standard Test Method for Slump of Sealants  |
| 20. ASTM D 2203 | Standard Test Method for Staining from Sealants   |
| 21. ASTM E 84   | Standard Test Method for Surface Burning Characteristics of Building Materials  |
| 22. ASTM E 90   | Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements |
| 23. ASTM E 814  | Standard Test Method for Fire Tests of Penetration Firestop Systems   |
| 24. ASTM E 1966 | Standard Test Method for Fire-Resistive Joint Systems   |
| 25. ASTM G 154  | Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials       |

**D. INTERIM FEDERAL SPECIFICATIONS (FS)**

- |                    |  |
|--------------------|--|
| 1. FS TT-S-00230C  | Sealing Compound: Elastomeric Type, Single Component   |
| 2. FS TT-C-1796A   | Caulking Compounds, Metal Seam and Wood Seam   |
| 3. FS TT-S-001543A | Sealing Compounds: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures) |

**E. SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)**

- |              |                                   |
|--------------|-----------------------------------|
| 1. Rule 1168 | Adhesive and Sealant Applications |
|--------------|-----------------------------------|

**F. UNDERWRITER'S LABORATORIES (UL)**

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

**1.4 SUBMITTALS**

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Material Safety Data Sheets (MSDS): Provide in accordance with 29 CFR 1910.1200,
- C. Hazard Communication
- D. Product Test Reports: Reports of tests required by this section performed by a qualified testing agency, indicating that the sealants comply with the requirements.
- E. VOC Content: Provide documentation of the Volatile Organic Content (VOC) in accordance with SCAQMD Rule 1168

- F. USDA Approval: Provide documentation that the product is approved for use in meat and poultry processing areas by the USDA for the following types of sealants:

1. Polyurethane
2. Tape Mastic
3. Non-skinning Sealant

## **1.5 WARRANTY**

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within 5 years of installation.

## **PART 2 PRODUCTS**

### **2.1 GENERAL MATERIAL REQUIREMENTS**

- A. Substrate Requirements: When testing is required on a substrate, the material used shall be either ASTM A653 G-90 or ASTM A792 AZ50 and tests shall be conducted with each of the following coatings:
1. Bare (No coating)
  2. Acrylic (Galvalume Plus)
  3. Polyester
  4. Siliconized Polyester
  5. Polyvinylidene Fluoride Resin (PVDF)

### **2.2 POLYURETHANE SEALANT**

- A. General: Provide Sealants that meet the following specifications:
1. ASTM C 920, Type S, Grade NS, Class 25, Use: NT, A, M, G and O paintable sealant
  2. AAMA 808.3
  3. FS TT-S-00230C, Type II, Class A
- B. Color: The sealant color shall be selected by OWNER.
- C. Physical Properties: The sealant shall have the following additional physical properties:
1. Peel Adhesion: All panels shall have at least a 90% cohesive failure of at least 15 lb/in when tested in accordance with ASTM C 794.
  2. Tensile Strength: Sealant shall have a tensile maximum of 300 psi and an elongation of 500-600% when tested in accordance with ASTM D 412.
  3. Sag: There shall be no sag when tested in accordance with ASTM C 639.
  4. Hardness: Shore "A" hardness on all three samples shall not exceed 40 when tested in accordance with ASTM C 661
  5. Service Temperature Range: -40 degrees F to 200 degrees F.
  6. Water Resistance: There shall be no presence of voids, cracks, separation, or breakdown of the compound when tested in accordance with AAMA 800-10, Section 2.11.1.

7. Flash Point: No less than 145 degrees F when tested in accordance with ASTM D 56.
8. Shelf Life: The compound shall have a shelf life of 9 months or more when stored at or below 80 degrees.
9. Skin Time: The compound shall have a skin time of 2-4 hours.
10. Cure Time: The compound shall have a cure time of 24-48 hours.
11. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

## **2.3 TAPE MASTIC SEALANT**

- A. General: Provide Sealants that meet the following specifications:
  1. AAMA 804.3
  2. AAMA 807.3
  3. FS TT-C-1796A, Type II, Class B
  4. Approved by Underwriters Laboratories for use in roof deck constructions classified under UL-518 Class 90
- B. Color: The sealant color shall be selected by OWNER.
- C. Physical Properties: The sealant shall have the following additional physical properties:
  1. Specific Gravity: 1.4 or higher when tested in accordance with ASTM D 792
  2. Tensile Adhesive Strength: 20 psi or higher when tested in accordance with ASTM C 908
  3. Elongation: 1000% or higher when tested in accordance with ASTM C 908
  4. Cone Penetration: The sealant shall meet the following conditions when tested in accordance with ASTM D 217 with a 300g cone in 5 seconds:
    - a. 8.5 – 100 mm at 77 degrees F
    - b. 125-135 mm at 120 degrees F
    - c. 45-55 mm at Zero degrees F
  5. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

## **2.4 SILICONE SEALANT**

- A. General: Provide sealants that meet the following specifications:
  1. ASTM C 920, Type S, Grade NS, Class 25
  2. AAMA 802.3, Type I and II
  3. AAMA 805.2 Group C
  4. AAMA 808.3
  5. FS TT-S-001543A, Class A
  6. FS TT-S-00230C, Class A
- B. Color: Clear
- C. Physical Properties: The sealant shall have the following additional physical properties:
  1. Mechanical Properties: The sealant shall have the following mechanical properties as determined by ASTM D 412:

- a. Tensile Strength: 150 psi minimum (Method A)
  - b. Modulus at 100% Elongation: 35 psi minimum
  - c. Elongation: 400% minimum
  - d. Recovery: 100%
2. Hardness: Maximum Shore A hardness of 15 when determined in accordance with ASTM C 661.
3. Tack-free Time: 1/4-inch diameter bead at 77 degrees F, 50% relative humidity, 10-15 minutes.
4. Cure Time: 1/4-inch diameter bead at 77 degrees F, 50% relative humidity, 10-12 hours.
5. Service Temperature: -60 degrees F to 300 degrees F.
6. Shelf Life: 9 months when stored in unopened original containers at 80 degrees F or less.
7. VOC Content: The Volatile Organic Compound (VOC) content shall be less than 250 g/L when calculated SCAQMD Rule 1168.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install joint sealants in accordance with manufacturer's specifications and requirements.

- END OF SECTION -

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**SECTION 08 10 00**  
**DOORS, FRAMES, AND HARDWARE**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This Section covers all the work necessary to furnish and install the new doors, frames, and hardware, complete and operable.
- B. All doors and their pressed steel frames shall be steel, insulated, and the type and size as indicated on the Door Schedule on the Contract Drawings.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:

- 1. Section 01 33 00 Submittal Procedures
- 2. Section 09 90 00 Painting and Finishes

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.

- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- 1. ANSI A 115.IG Installation Guide for Doors and Hardware
- 2. ANSI A 156.6 Standard for Architectural Door Trim
- 3. ANSI A 156.16 Standard for Auxiliary Hardware
- 4. ANSI A 250.8 SDI-100 Recommended Specifications for Standard Steel Doors and Frames
- 5. ANSI A 250.10 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
- 6. ANSI A 250.11 Recommended Erection Instructions for Steel Frames

- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- 1. ASTM A 36 Standard Specification for Carbon Structural Steel
- 2. ASTM A 108 Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
- 3. ASTM A 123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- 4. ASTM A 229 Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs
- 5. ASTM A 653 Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
- 6. ASTM A 1008 Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable
- 7. ASTM A 1011 Standard Specification for Steel, Sheet and Strip, Hot-Rolled,

- |                 |   |
|-----------------|---|
|                 | Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength                           |
| 8. ASTM C 177   | Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus      |
| 9. ASTM D 256   | Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics   |
| 10. ASTM D 635  | Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position                   |
| 11. ASTM D 790  | Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials                         |
| 12. ASTM D 792  | Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement   |
| 13. ASTM D 882  | Standard Test Method for Tensile Properties of Thin Plastic Sheet   |
| 14. ASTM D 1622 | Standard Test Method for Apparent Density of Rigid Cellular Plastics  |
| 15. ASTM D 2583 | Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor  |
| 16. ASTM E 84   | Standard Test Method for Surface Burning Characteristics of Building Materials  |
| 17. ASTM E 90   | Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements                           |
| 18. ASTM E 330  | Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference |
| 19. ASTM E 413  | Classification for Rating Sound Insulation  |

D. AMERICAN WELDING SOCIETY (AWS)

- |             |                                       |
|-------------|---------------------------------------|
| 1. AWS D1.1 | Structural Welding - Steel            |
| 2. AWS D1.3 | Structural Welding Code – Sheet Steel |

## 1.4 SUBMITTALS

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's catalog data and preprinted installation instructions of doors.
- C. A schedule showing the location of each door shall be included with the Submittal drawings. Submittal drawings shall include elevations of each door type, details and method of anchorage, details of construction, method of assembling sections, location and installation of hardware, shape and thickness of materials, details of joints and connections.
- D. Manufacturer's certificates that certify products meet or exceed the specified requirements.
- E. Warranty: Provide documentation of the manufacturer's standard written one (1) year warranty.



## 1.5 DELIVERY AND STORAGE

- A. Doors shall be delivered to the job site wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dust or water, and in a manner that permits easy access for inspection and handling. Doors shall be handled carefully to prevent damage to the faces, edges, and ends. Damaged items that cannot be restored to like-new condition shall be replaced.

## PART 2 PRODUCTS

### 2.1 STEEL DOORS

- A. Steel doors and frames shall be of hollow metal construction and shall be full flush design with no visible seams. Interior and Exterior door face sheets shall be hot-dip galvanized according to the requirements of ASTM A 653. Manufacturer's shall be **Republic Doors and Frames, Steelcraft, Ceco Door Products**, or approved equal. Doors shall conform to ANSI A 250.8 and to the following requirements:
  - 1. Hollow metal door, 1-3/4 inches thick flush type, constructed of two sheets of not less than stretcher leveled, 16-gauge steel sheets formed and welded for flush pan assembly, with internal 20-gauge vertical reinforcing channels spaced not over 8 inches on centers the full height of the door. There shall be no visible joints on the face of the doors. Reinforcing channels shall be uniformly spot welded to face plates at top and bottom of all doors. Filler channels shall be provided at the top and bottom of doors to provide a flush closure. The top of exterior doors shall be provided with flush, water- and weather-tight top enclosures.
  - 2. All interior void spaces shall be completely filled with EPS foam or polyurethane.
  - 3. Concealed sheet or bar steel reinforcement shall be provided for mortise type hardware. Reinforcing shall not be less than the following: 9-gauge for butts, 12-gauge for locksets and 14-gauge for surface applied hardware. Reinforcing shall be drilled and tapped to template requirements. Concealed reinforcing shall be provided for closures. Door bottom weather stripping shall be included to match thresholds.
  - 4. Door frames shall be pressed steel constructed of not less than 16-gauge steel and shall be of the shape indicated on the plans and as required to fit the various wall constructions. Frames shall be of welded unit construction assembled and welded in the shop. Welding shall be to a hairline joint with all exposed beads ground smooth.
  - 5. Concealed reinforcing of the frames for the mortise hardware shall be not less than the following: 3/16 inch for butts, 12-gauge for lock strike, 14-gauge for surface applied items and 18-gauge for plaster guards over mortised hardware reinforcement. Frames shall be mortised drilled, and tapped to template requirements. Lock reinforcing units shall be supplied by finishing hardware supplier. Frames shall be anchored as shown in the Contract Drawings.
  - 6. Hinges shall be heavy duty ball bearing hinges with non-removable pins.
  - 7. Pull plates shall be chrome plated or stainless steel and mounted on interior and exterior sides of all doors.
  - 8. All double doors are to be supplied with a "Z" astragal of 14-gauge steel for 1-3/4-inch doors and 16-gauge for 1-3/8-inch doors.
  - 9. Hardware including locksets and hinges shall be stainless steel.

## 2.2 DOOR HARDWARE

- A. Trim material shall be stainless steel, unless noted otherwise.
- B. Pull Plates: 8" CTC pull, 4" x 16" plate, stainless steel, No. 110 x 70C by **Rockwood Mfg. Co.**, or approved equal, conforming to ANSI A 156.6.
- C. Hinges: Satin stainless steel, 5 knuckles minimum, non-rising pin for interior doors and non-removable pin for exterior doors, number of hinges per door manufacturer's recommendation (minimum of 3 hinges per door). Where necessary to keep door leaf clear of walls, casings, jambs or reveals in door opening, wide throw hinges of an approved type shall be furnished. Finish shall be stainless steel satin (32D or 630). Manufacturer shall be **Mckinney T4A3386, Hager, Stanley Works FBB199 (32D)**, or approved equal.
- D. Cylinder Lock Set: Best Access Systems, Lockset 47H-7-AB-15-J-630-SH-S6-VT for exterior doors and 45H-7-N-15-M-630 for interior doors. Locks must be compatible with OWNER's existing keys. CONTRACTOR shall provide lock sets and keys that will match OWNER's requirements.
- E. Lever Extension Flush Bolt, Upper, **Rockwood No. 555**, or approved equal, cadmium plated finish (inactive leaf only), conforming to ANSI A 156.16.
- F. Lever Extension Flush Bolt, Lower, **Rockwood No. 555**, or approved equal, cadmium plated finish (inactive leaf only), conforming to ANSI A 156.16.
- G. Threshold: **#277AS by Pemko Corporation**, or approved equal, raised interior, extruded aluminum threshold with neoprene seal.
- H. Drip Cap: Provide drip cap on all exterior doors. Drip cap shall be clear anodized aluminum, **Pemko 346C**, or approved equal.
- I. Door Closers: Door closers shall be full rack and pinion, cast iron, with adjustable regulators for closing and latching speed, back check and spring power. Closers shall be mounted for 180 degrees of swing whenever possible. All closers shall be LCN Model 4040XP with 4041-3071 DEL cylinder with extra duty hold open arm. Mounting plates shall be supplied as necessary. All door closers attached to mineral core or particle filled doors shall be installed with hex bolts. Cover shall be metal 4040XP-72MC with 689 Aluminum finish.
- J. Lock Strikes: Strikes shall have extended curved lips where required to protect trim from being marred by latch bolt. Strike lips shall not protrude more than 1/8-inch beyond door frame trim. Wrought box strikes shall be furnished on all locks, latches and deadlocks.
- K. Door Stop: Solid cast brass, DuraFlex bumper, **Rockwood #445**, or approved equal (Inactive leaf only)
- L. Non-Mortise Door Edge with Astragal: 0.06" thick stainless steel, **Rockwood HD306B-AST**, or approved equal (double doors only)
- M. Kick Plates: Unless otherwise indicated, kick plates shall be provided and shall be satin stainless 18-8, 18 gage, **Rockwood No. K1050F**, or approved equal.

N. Weatherstripping and Seals: silicone gasketing, **Pemko S88D**, or approved equal.

A.

## **2.3 ACCESS DOORS AND FRAMES MISCELLANEOUS**

- A. Fabricate doors and frames as shown in the Contract Drawings and in accordance with best shop practices. Frames shall be rigid, neat in appearance and free from defects. Field measurements shall be taken as required for coordination with adjoining work.
- B. Form exposed surfaces free from warp, wave and buckle, with all corners square, unless otherwise shown. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.
- C. Reinforce members and joints with plates, tubes or angles for rigidity and strength.
- D. Doors and frames shall be mortised and reinforced for hardware in accordance with the hardware manufacturer's instructions and templates. The reinforcing shall be designed to receive hinges, locks, strikes, closures, etc.
- E. Mortar guard boxes shall be provided for hardware cutouts in frames.
- F. Furnish at least three (3) metal anchors or polymer spacers in each jamb of frames up to 84" high and one (1) additional anchor for each 24" in height above 84", in shapes, sizes and spacing shown or required for anchorage into adjoining wall construction. Fabricate joint anchor of stainless steel.
- G. Terminate bottom of frames at the indicated finished floor level.
- H. Provide clearance for doors of 1/8" at jambs and heads; 1/4" clearance above threshold.
- I. Where glazing is required, flush integral stops on one side and screw-on stops on the opposite side shall be provided.

## **2.4 FINISH**

- A. Surfaces shall be provided with a shop-primed galvanized finish. Prior to receiving primer, all surfaces shall be cleaned thoroughly and phosphate-treated to assure maximum paint adherence. Primer shall be a metallic oxide or synthetic resin primer of the manufacturer's standard type and shall be applied by dipping or spraying in accordance with ANSI A 250.10.
- B. Field painting of doors and frames shall be in accordance with Section 09 90 00 – Painting and Finishes. Finish coat shall be compatible with the shop applied primer coating.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Doors shall be installed in accordance with approved Submittal drawings, Contract Drawings, and manufacturer's instructions and in accordance with ANSI A 115IG. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be weather tight and shall be free from

warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

**B. Access Door Frame Installation**

1. Place frames prior to construction of enclosing walls and ceilings. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged. Frame must not be drilled for brace supports as finish may be damaged. Install frames in accordance with ANSI A 250.11.
2. Locate three (3) wall anchors per jamb at hinge and strike levels. Frames may be grouted full of mortar at jambs and anchors shall be built into the joints as walls are laid up. A continuous bead of silicone sealant is to be applied between the head and jamb at the miter joint.

**C. Adjust doors for free swing without binding. Adjust hinge sets, locksets, and other hardware. Lubricate using a suitable lubricant compatible with the door and frame coatings.**

**D. Install work of this Section in strict accordance with approved shop drawings and manufacturer's recommended installation instructions. Where installations require field welding, all work must be performed by certified welders in accordance with AWS D1.1/D1.3.**

**E. Upon installation, secure the services of a qualified representative of the manufacturer to visit the jobsite and inspect the complete installation of the door and frame assemblies, test all components thru a minimum of ten (10) cycles of operation and direct installer in correcting any non-conforming items found.**

**F. Remove temporary coverings. Repair or replace damaged installed products. Clean installed products in accordance with the manufacturer's instructions before acceptance by OWNER.**

**G. Clearances at edge of doors:**

1. Between door and frame at head and jambs: 1/8 inch.
2. At meeting edges pairs of doors and at mullions: 1/8 inch.
3. At transom panels, without transom bars: 1/8 inch.
4. At sills without thresholds: 5/8-inch maximum above finish floor.
5. At sills with thresholds: 1/8-inch above threshold.

**3.2 HARDWARE SCHEDULE**

- A. The hardware schedule is arranged for convenience of locating hardware and does not preclude in any way the requirements that all necessary hardware shall be furnished and properly installed. Hardware not specifically called out shall be similar to that required for similar uses.**
- B. Hardware equal in quality and utility will be accepted provided it conforms in operation, quality, weight, size, workmanship, and finish to the products hereinafter described. All component parts of locksets shall be the product of one manufacturer.**

<b>Hardware Set 100 (D1)</b>				
Each to Receive:				
Quantity	Item	Model No.	Finish	Manufacturer
3 each*	Hinge	T4A3386 4.5"x4.5"	32D	McKinney
1 each	Lockset	47H-7-AB-15-J-630-SH-S6-VT	630	Best Access Systems
1 each	Closer	4040XP	689	LCN
1 each	Kickplate	K1050F	630	Rockwood
1 each	Wall Stop	409	32D	Rockwood
3 each	Silencer	608	Gray	Rockwood
1 each	Threshold	277AS	Alum	Pemko
1 each	Drip Cap	346C	Alum	Pemko
1 set	Perimeter Seal	S88D	Alum	Pemko
*Five Knuckle, Stainless Steel, Non-removal Pin Hinges (size and quantity by door manufacturer)				

<b>Hardware Set 200 (D3)</b>				
Each to Receive:				
Five Knuckle, Stainless Steel, Non-removal Pin Hinges (size and quantity by door manufacturer)				
Quantity	Item	Model No.	Finish	Manufacturer
1 each*	Lockset	47H-7-AB-15J-M-630-SH-S6-VT	630	Best Access Systems
3 each***	Hinge	T4A3386-NRP 4.5"x4.5"	32D	McKinney
1 each	Closer	4040XP	689	LCN
1 each	Kickplate	K1050F	630	Rockwood
1 each	Astragal	HD306B-AST	630	Rockwood
1 each**	Flush Bolt, upper	555	626	Rockwood
1 each**	Flush Bolt, lower	555	626	Rockwood
1 each	Threshold	277AS	Alum	Pemko
1 each	Drip Cap	346C	Alum	Pemko
1 set	Perimeter Seal	S88D	Alum	Pemko
* Deadbolt required on Active Leaf only				
** Inactive Leaf Only				
***Five Knuckle, Stainless Steel, Non-removal Pin Hinges (size and quantity by door manufacturer)				

<b>Hardware Set 300 (D5)</b>				
Each to Receive:				
Quantity	Item	Model No.	Finish	Manufacturer
3 each*	Hinge	TCA2314 4.5"x4.5"	630	McKinney

1 each	Lockset	45H-7-LT-15-H-630	630	Best Access Systems
1 each	Kickplate	K1050F	630	Rockwood
1 each	Wall Stop	409	32D	Rockwood
3 each	Silencer	608	Gray	Rockwood
1 each	Bottom Sweep	3151SSN	Stn Stl	Pemko
*Five Knuckle, Stainless Steel, Hinges (size and quantity by door manufacturer)				

Hardware Set 400 (D2)				
Each to Receive:				
Quantity	Item	Model No.	Finish	Manufacturer
3 each*	Hinge	MKCL-180*	630	McKinney
1 each	Lockset	45H-7-LT-15-H-630	630	Best Access Systems
1 each	Closer	4040XP	Stn Stl	LCN
1 each	Kickplate	K1050F	630	Rockwood
1 each	Threshold	277AS	Alum	Pemko
1 set	Perimeter Seal	2815CM	Alum	Pemko
* Cam lift hinges, stainless steel (size and quantity by door manufacturer)				

- END OF SECTION -

**SECTION 08 31 00**  
**ACCESS HATCHES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This section covers all the work necessary to furnish and install all hatches and appurtenances, complete and in place as shown on the Contract Drawings.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 09 90 00 Painting and Finishes

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 123      Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
  - 2. ASTM A 229      Standard Specification for Steel Wire, Quenched and Tempered for Mechanical Springs
  - 3. ASTM A 36      Standard Specification for Carbon Structural Steel
  - 4. ASTM A 653      Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process

**1.4 DESIGN REQUIREMENTS**

- A. Any hatch in a roadway or located where occasional, slow traffic may drive over the hatch shall be designed to meet H-20 highway wheel loading. For continuous or heavy traffic, use hinged cast iron castings with lift assist type covers.
- B. Flush mounted hatches for vaults not subject to traffic loading shall be designed to handle a minimum live loading of 300 psf.
- C. Shoe-box type hatches for potable water reservoirs shall be designed to handle a live load of 100 psf.
- D. Hatches for water reservoirs or spring boxes shall meet the requirements of the Utah Administrative Code Section R309-545-14.

**1.5 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

- B. Submit manufacturer's catalog data and preprinted installation instructions for the hatches.
- C. Submit a schedule showing the location of each hatch. Shop drawings shall include details and method of anchorage, details of construction, method of assembling sections, location and installation of hardware, shape and thickness of materials, details of joining and connections.

## **1.6 DELIVERY AND STORAGE**

- A. Hatches shall be delivered to the job site wrapped in a protective covering with the brands and names clearly marked thereon.

## **1.7 WARRANTY**

- A. Manufacturer shall provide to OWNER written guarantee against defects in material or workmanship for a period of five (5) years. Manufacturer must be able to have a representative on site within 48 hours to address any complaint or issues.

# **PART 2 PRODUCTS**

## **2.1 HATCHES AND ACCESS DOORS**

- A. Hatches or access doors shall be as noted in the Contract Drawings and meet the requirements specified herein. All hardware shall be stainless steel throughout. Each hatch shall be provided with a permanent label showing the manufacturer's name and address and the model number. Hatches shall have stainless steel hold open arm with positive locking. The hold open arm shall be coated red.
- B. Hatches or access doors shall be Type 316 stainless steel, unless noted otherwise, in corrosive conditions or environments and galvanized steel or aluminum as noted in all other areas. Aluminum frames to be cast in concrete shall be mill finished with a bituminous coating applied to the exterior of the frame. Steel hatches and access doors shall be hot-dip galvanized per ASTM A 123 or ASTM A 653. All hardware shall be stainless steel throughout.
- C. Hatch hardware, including the hinges, shall be fabricated from Type 316 stainless steel.
- D. Hatches shall be provided with an automatic hold-open arm with release handle.
- E. Hatches shall be designed to be watertight and equipped with an EPDM gasket.
- F. Unless otherwise indicated in the Contract Drawings, a fall protection system shall be provided on all hatches which are 6 feet or more above a lower level. Fall protection systems shall be grating panels that conform to OSHA 29 CFR1926.502(c) requirements. The fall protection grating shall be epoxy coated with an OSHA type safety orange color. Safety nets or safety grates fabricated from fiberglass or fiberglass blend are not acceptable, unless approved by OWNER and ENGINEER.
- G. Hatches for water reservoirs shall have the interior and exterior handles eliminated and shall have a concealed padlock hasp. The hasp shall be protected from tampering on at least three (3) sides.



- H. Hatches for water reservoirs or spring boxes shall have a close fitting shoebox type cover which extends down around the frame at least two inches with a gasket between the cover and the frame. The three non-hinged sides of the hatch shall be provided with adjustable cam levers to tighten the cover against the gasket to ensure the hatch is watertight. Hinge fasteners must be completely concealed to inhibit tampering.
- I. Hatches shall be supplied with built-in, or CONTRACTOR installed position intrusion switches as specified in the Contract Drawings.
- J. Manufacturers shall be **USF Fabrication, Inc., EJ (formerly East Jordan Iron Works)**, or approved equal.

## 2.2 ROOF HATCHES

- A. Furnish and install metal roof hatch per the size, type, and location indicated in the Contract Drawings. The roof hatch shall be pre-assembled by the manufacturer.
- B. Performance characteristics:
  - 1. Covers shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
  - 2. Operation of the covers shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
  - 3. Operation of the covers shall not be affected by temperature.
  - 4. Entire hatch shall be weather tight with fully welded corner joints on covers and curb
- C. Covers: Shall be 11-gauge aluminum with a 3-inch beaded flange with formed reinforcing members. Covers shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
- D. Cover insulation: Shall be fiberglass of 1-inch thickness, fully covered and protected by a metal liner 18-gauge aluminum.
- E. Curb: Shall be 12-inch in height and of 11-gauge aluminum. The curb shall be formed with a 3-1/2-inch flange with 7/16-inch holes provided for securing to the roof deck. The curb shall be equipped with an integral metal cap flashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system or equal, including stamped tabs, 6-inch on center, to be bent inward to hold single ply roofing membrane securely in place.
- F. Curb insulation: Shall be rigid, high-density fiberboard of 1-inch thickness on outside of curb.
- G. Lifting mechanisms: Manufacturer shall provide compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and closing. The upper tube shall be the outer tube to prevent accumulation of moisture, grit, and debris inside the lower tube assembly. The lower tube shall be welded to the curb assembly; for steel construction: through bolted to the curb assembly.
- H. Hardware

1. Heavy pintle hinges shall be provided
  2. Covers shall be equipped with an enclosed two-point spring latch with interior and exterior turn handles
  3. Roof hatch shall be equipped with interior and exterior padlock hasps.
  4. The latch strike shall be a stamped component bolted to the curb assembly.
  5. Covers shall automatically lock in the open position with a rigid hold open arm equipped with a 1-inch diameter red vinyl grip handle to permit easy release for closing.
  6. Hardware: All hardware shall be Type 316 stainless steel hardware.
  7. Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.
- I. Finishes: Factory finish shall be mill finish aluminum.
- J. Roof hatch manufacturers shall be **The Bilco Company, Babcock-Davis**, or approved equal.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Hatches shall be installed in accordance with the approved detailed shop drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, hatches shall be weather tight and shall be free from warp, twist, or distortion. Hatches shall be lubricated, properly adjusted, and demonstrated to operate freely.
- B. All surfaces that come in contact with the concrete shall have a protective coating.
- C. Unless otherwise indicated in the Contract Drawings, a 1-inch PVC Schedule 80 drainpipe shall be provided from all channel frame roof or vault hatches to within 6 inches of the floor if the structure has a floor drain or a sump pump. Extend the drainpipe to the sump pump or as close as possible to a floor drain without running the pipe on the floor. If a floor drain is not available, the hatch drain shall be extended to drain to the ground surface to a location that will not promote surface ponding of the drain water.

- END OF SECTION -

**SECTION 08 33 23**  
**OVERHEAD COILING DOORS**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This section covers all the work necessary to furnish and install new overhead coiling doors, frames, motors, and hardware, complete and operable.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limit to:

1. Section 01 33 00 Submittal Procedures
2. Section 05 50 00 Miscellaneous Specialties
3. Section 09 90 00 Painting and Finishes

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.

B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
2. ASTM D 3363 Standard Test Method for Film Hardness by Pencil Test
3. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
4. ASTM E 90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

C. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

1. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

D. American Society OF CIVIL ENGINEERS (ASCE)

1. ASCE-7 Minimum Design Loads for Buildings and Other Structures

E. UNDERWRITERS laboratories (UL)

1. UL 325 Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Manufacturer's catalog product data and preprinted installation instructions of doors.

- C. A schedule showing the location of each door shall be included with the shop drawings. Submittal drawings shall include elevations of each door type, details and method of anchorage, details of construction, wiring diagrams in motors are required, locations of louvers and glass if required, method of assembling sections, location and installation of hardware, shape and thickness of materials, details of joints and connections.
- D. Submit calculations stamped by a registered engineer showing connections are designed to meet code requirements and loads.
- E. Provide manufacturer and installer qualifications as noted below.
- F. Manufacturer's certificates that certify products meet or exceed the specified requirements.
- G. Submit operation and maintenance manual.

## **1.5 DELIVERY AND STORAGE**

- A. Doors shall be delivered to the job site wrapped in a protective covering with the brands and names clearly marked thereon. Doors shall be stored in a dry location that is adequately ventilated and free from dust or water, and in a manner that permits easy access for inspection and handling. Doors shall be handled carefully to prevent damage to the faces, edges, and ends. Damaged items that cannot be restored to like-new condition shall be replaced.

## **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: A minimum of five (5) years experience in producing doors of the type specified.
- B. Installer Qualifications: Installer must be approved or certified by the manufacturer.

## **1.7 WARRANTY**

- A. Standard Warranty: Two years from date of shipment against defects in material and workmanship.

## **PART 2 PRODUCTS**

### **2.1 OVERHEAD COILING DOORS**

- A. **General:** Overhead coiling doors (roll-up doors) shall be of the metal curtain slat design, motor operated and shall be weather and dust-resistant. Wiring diagrams shall be submitted for motor operated doors. Doors shall be provided complete with slats, guides, hoods, reduction gears, galvanized hand chain, operating mechanism, motors, controls, wiring, brackets, gears, head, bottom and side weather stripping, hardware, and other items necessary for complete installation and operation.
- B. **Wind Loading:** The doors shall be designed to withstand a wind load of 20 psf.
- C. Air infiltration shall comply with ASHRAE 90.1 requirements of less than 1.0 CFM/SF.
- D. Cycle Life: Design doors of standard construction for normal use of up to 20 cycles per day maximum and an overall maximum of 50,000 operating cycles for the life of the door.

- E. Provide manufacturer's seismic calculations confirming ASCE 7-05.
- F. Manufacturer, or approved equal:

- 1. Cookson Model TMWI
- 2. Cornell Model ESD30
- 3. Overhead Door Stormtite Series

## 2.2 MATERIALS

- A. **Curtain:** Shall have an air infiltration rate of less than 0.4 CFM/SF, validated by an independent testing agency.
  - 1. Fabrication:
    - a. Slat Material: No. 6F or 3/4-inch minimum by 2-1/2-inch minimum, (Listed Exterior/Interior):
      - 1) Galvanized Steel/Galvanized Steel: Manufacturer recommended gauge based on performance requirements. Minimum 24/24 gauge, Grade 40, ASTM A 653 galvanized steel zinc coating
    - b. Insulation: foamed-in-place, closed cell urethane. Insulation shall be CFC Free with an Ozone Depletion Potential (ODP) rating of zero.
    - c. Flame Spread Index of 5 and a Smoke Developed Index of 10 as tested per ASTM E 84
    - d. R-value: 7.7 minimum (U-value of 0.125) per ASHRAE.
    - e. STC Rating: STC 21 for the entire assembly, as tested per ASTM E 90 and based on testing a complete, operable assembly.
  - 2. Exterior and Interior Slat Finish:
    - a. ColorCote®, PowderGuard®, or approved equivalent Powder Coat Coating System:
    - b. ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat.
    - c. Phosphate treatment followed by baked-on polyester powder coat, with color as selected by OWNER from manufacturer's standard color range; minimum 2.5 mils cured film thickness; ASTM D 3363 pencil hardness: H or better.
- B. **Endlocks:** Fabricate interlocking sections with high strength nylon or galvanized cast iron endlocks on alternate slats each secured with two 1/4 inch rivets. Provide windlocks as required to meet specified wind load.
  - 1. **Nylon:** Required up to 21'-5" width (DBG - Distance Between Guides)
  - 2. **Galvanized cast iron:** Required if above 21'-5" width (DBG - Distance Between Guides)
- C. **Insulated Bottom Bar:** Reinforced extruded aluminum interior face with full depth insulation and exterior skin slat to match curtain material and gauge. Minimum 4" tall x 1-1/16-inch thickness.
  - 1. Finish:
    - a. Exterior: Match slats
    - b. Interior: Powder coat to match slats
  - 2. Air Infiltration Certification Label: Must be affixed to bottom bar

D. Guides:

1. Fabrication:
  - a. Thermal break required: Minimum 3/16-inch stainless steel angles. Provide windlock bars of the same material when windlocks are required to meet specified wind load. The top of inner and outer guide angles to be flared outwards to form bellmouth for smooth entry of curtain into guides. Provide removable guide stoppers to prevent over travel of curtain and bottom bar.
2. Finish:
  - a. Stainless Steel: Type 304 #4 Finish

E. Counterbalance Shaft Assembly:

1. Barrel: Steel pipe capable of supporting curtain load with maximum deflection of 0.03 inches per foot of width.
2. Spring Balance: Oil-tempered, heat-treated steel helical torsion spring assembly designed for proper balance of door to ensure that maximum effort to operate will not exceed 25 lbs. Provide wheel for applying and adjusting spring torque.

F. Brackets: Fabricate from minimum 3/16-inch steel plate with permanently lubricated ball or roller bearings at rotating support points to support counterbalance shaft assembly and form end closures.

1. Finish: Hot-dip galvanized per ASTM A 123, Grade 85 zinc coating. Hot-dip galvanize after fabrication.

G. Hood: Minimum 24-gauge galvanized steel with reinforced top and bottom edges. Provide minimum 1/4-inch steel intermediate support brackets as required to prevent excessive sag.

1. Finish:
  - a. ColorCote®, PowderGuard®, or approved equivalent Powder Coat Coating System:
    - 1) ASTM A 653 galvanized base coating treated with dual process rinsing agents in preparation for chemical bonding, gray baked-on base coat and gray baked-on polyester finish coat.
    - 2) Phosphate treatment followed by baked-on polyester powder coat, with color as selected by OWNER from manufacturer's standard color range; minimum 2.5 mils cured film thickness; ASTM D 3363 pencil hardness: H or better.

H. Weather Stripping:

1. Bottom Bar:
  - a. Manually Operated Doors: Replaceable, bulb-style, compressible EDPM gasket extending into guides.
  - b. Motor Operated Doors: Sensing/weather edge with neoprene astragal extending full width of door bottom bar.
2. Guides: Replaceable vinyl strip on guides sealing against both sides of curtain.
3. Lintel Seal: Nylon brush seal fitted at door header to impede air flow.
4. Hood: Neoprene/rayon baffle to impede air flow above coil.

## 2.3 OPERATION

- A. **Manual Chain Hoist:** Provide chain hoist operator with endless steel chain, chain pocket wheel and guard, geared reduction unit, and chain keeper secured to guide. Fabricate gear box to completely enclose operating mechanism and be oil tight.
- B. **Motor Operator:** The operator must not extend above or below the door coil when mounted front-of-coil. Rated for a maximum of 20 cycles per hour (not to be used for consecutive hours) UL listed, Totally Enclosed Non-Ventilated gear head operator(s) rated 3/4-hp as recommended by door manufacture for size and type of door, 480 Volts, Three Phase, 60 Hz. Provide complete with electric motor and factory pre-wired motor control terminals, maintenance free solenoid actuated brake, emergency manual chain hoist, and control station. Motor shall be high starting torque, industrial type, protected against overload with an auto-reset thermal sensing device. Primary speed reduction shall be heavy-duty, lubricated gears with mechanical braking to hold the door in any position. Operator shall be equipped with an emergency manual chain hoist assembly that safely cuts operator power when engaged. A disconnect chain shall not be required to engage or release the manual chain hoist. Operator drive and door driven sprockets shall be provided with #50 roller chain. Provide an integral Motor Mounted Interlock system to prevent damage to door and operator when mechanical door locking devices are provided. Operator shall be capable of driving the door at a speed of 8 to 9 inches per second. Fully adjustable, driven linear screw type cam limit switch mechanism shall synchronize the operator with the door. The Electrical Contractor shall mount the control station and supply the appropriate disconnect switch, all conduit and wiring per the overhead door wiring instructions. The motor-operated doors, motors, controls, safety devices, and wiring shall conform to requirements of governing codes and authorities. The motor operator shall be **Cookson Model SG, Cornell Model MG, Overhead Door Model RHX**, or approved equal.
- C. Control Station: "Open/Close" key switch with "Stop" push button in a NEMA 3R enclosure.
- D. Control Operation:
  - 1. Momentary Contact to Close, Fail-safe UL 325 Compliant entrapment protection for motor operation; 2-wire, E.L.R. electric sensing/weather edge extending full width of door bottom bar. Contact before door fully closes shall cause door to immediately stop downward travel and reverse direction to the fully opened position.
  - 2. Sensing/Weather Edge: Automatic reversing control by an automatic sensing switch within neoprene or rubber astragal extending full width of door bottom bar.
    - a. Electric sensing edge device. Provide a wireless sensing edge connection to motor operator eliminating the need for a physical traveling electric cord connection between bottom bar sensing edge device and motor operator.

## 2.4 ACCESSORIES

- A. Locking: For non-motor operated doors, provide a master keyable cylinder operable from both sides of bottom bar, options for all types of operation. Cylinder shall be standard mortise cylinder.
- B. Operator and Bracket Mechanism Cover: If the operator components are lower than 8 feet above finish floor level, provide minimum 0.040-inch aluminum sheet metal cover to enclose exposed moving operating components at coil area of unit.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates upon which work will be installed and verify conditions are in accordance with approved shop drawings.
- B. Coordinate with responsible entity to perform corrective work on unsatisfactory substrates.
- C. Commencement of work by installer is acceptance of substrate.

### **3.2 INSTALLATION**

- A. General: Install overhead coiling door and operating equipment with necessary hardware, anchors, inserts, hangers, and supports in accordance with the manufacturer's installation instructions. Overhead coiling doors shall be bolted to the steel frames. **Welding the overhead coiling doors to the steel frames will NOT BE PERMITTED.**
- B. Doors and frames shall be accurately cut, fitted, and installed level, square, plumb, and in alignment. Fasteners shall be of sufficient length and shall be sized for loads imposed.
- C. The installation of the motor operators shall be in accordance with the manufacturer's installation instructions and as required by Division 26.

### **3.3 ADJUSTING**

- A. Following completion of installation, including related work by others, lubricate, test, and adjust the doors for ease of operation, free from warp, twist, or distortion.

### **3.4 CLEANING**

- A. Clean surfaces soiled by work as recommended by the manufacturer.
- B. Remove surplus materials and debris from the site.

### **3.5 DEMONSTRATION**

- A. Demonstrate proper operation to OWNER's Representative.
- B. Instruct OWNER's Representative in maintenance procedures.

- END OF SECTION -



**SECTION 08 51 13**  
**ALUMINUM WINDOWS**

**PART 1      GENERAL**

**1.1   SUMMARY**

- A. Furnish and install single hung, impact resistant, aluminum historic architectural windows complete with hardware and related components as shown on Contract Drawings and specified in this Section.

**1.2   RELATED WORK**

- A. Related work in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 07 92 00 Joint Sealants

**1.3   REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.

**B. AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)**

1. AAMA/WDMA/101/I.S.2/A440      Voluntary Specification for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
2. AAMA 910                              Voluntary "Life Cycle" Specifications and Test Methods for Architectural Grade Windows and Sliding Glass Doors.
3. AAMA 1503.1                          Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.

**C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)**

1. ASTM E 283                          Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen.
2. ASTM E 331                          Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
3. ASTM E 1886                          Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Missiles and Exposed to Cyclic Pressure Differentials.
4. ASTM E 1996                          Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Storm Shutters Impacted by Windborne Debris in Hurricanes.

#### D. SCREEN MANUFACTURERS ASSOCIATION (SMA)

1. SMA 1004                      Specifications for Aluminum Tubular Frame Screens for Windows

### 1.4 SUBMITTALS

- A. CONTRACTOR shall provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  1. Preparation instructions and recommendations.
  2. Storage and handling requirements and recommendations.
  3. Installation methods.
- C. Shop Drawings:
  1. Elevation for each style window specified indicating its size, glazing type, muntin type and design.
  2. Manufacturer's head, jamb and sill details and section views for each window type specified.
- D. Samples: Provide color samples for window frame, sill, pans, and trim for OWNER to select final color.
- E. Schedules:
  1. Provide a window schedule indicating the type, size, color, and operation of each unit specified. Coordinate with window mark types found in the Contract Drawings.
- F. Test Reports: Submit certified independent testing agency reports indicating window units meet or exceed specified performance requirements.

### 1.5 TESTING AND PERFORMANCE REQUIREMENTS

#### A. Test Units

1. Air, water, and structural test unit shall conform to requirements set forth in ANSI/AAMA/WDMA 101/I.S.2 and AAMA 910.

#### B. Test Procedures and Performances

1. Windows shall conform to all AAMA/ANSI/WDMA-101/I.S.2 and AAMA 910 requirements for the window type referenced in 1.01.B. In addition, the following specific performance requirements shall be met.
2. Air Infiltration Test
  - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 283 at a static air pressure difference of 6.24 psf.
  - b. Air infiltration shall not exceed 0.04 cfm/sf.
3. Water Resistance Test
  - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 331 and ASTM E 547 at a static air pressure difference of 12 psf.
  - b. There shall be no uncontrolled water leakage.

4. Uniform Structural Test
  - a. With window sash and ventilators closed and locked, test unit in accordance with ASTM E 330 at static air pressure (positive and negative) difference 150% of design pressure.
  - b. At conclusion of test, there shall be no glass breakage; no permanent damage to fasteners, hardware parts, support arms, or actuating mechanisms; no other damage which would cause window to be inoperable.
5. Condensation Resistance Test (CRF)
  - a. With window sash and ventilators closed and locked, test unit in accordance with AAMA 1503.1.
  - b. Condensation Resistance Factor (CRF) shall not be less than 50 for the frame and 56 for the glass.
6. Thermal Transmittance Test (Conductive U-Value)
  - a. With window sash and ventilators closed and locked, test unit in accordance with NFRC 100 and AAMA 1503.1.
  - b. Conductive thermal transmittance (U-Value) shall have a range between 0.35 to 0.56 BTU/hr/ft<sup>2</sup>/°F.
7. Life Cycle Test
  - a. Test window in accordance with AAMA 910.
  - b. At conclusion of test, there shall be no damage to fasteners, hardware parts, support arms, or actuating mechanisms; no other damage which would cause window to be inoperable. Subsequent air infiltration and water resistance tests shall not exceed specified requirements.
8. Forced Entry Resistance Test: ASTM F 588, Type A and Grade 10.

C. Design Loads: See Structural Notes in the Contract Drawings.

## **1.6 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: All windows and window hardware specified in this section will be supplied by a single manufacturer with a minimum of ten (10) years' experience.
- B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing windows of the same type and scope as specified.
- C. Provide test reports from AAMA accredited laboratory certifying that window units are found to be in compliance with AAMA/WDMA 101/I.S.2 and performance standards listed above.
  1. Test reports shall be accompanied by the window manufacturer's letter of certification stating that the tested window meets or exceeds criteria for the appropriate AAMA/WDMA 101/I.S.2 test.
- D. Code Compliance: Provide windows that comply with regulations of the code bodies having jurisdiction.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging until ready for installation in accordance with manufacturer's recommendations.

- B. Protect units against damage from the elements, construction activities and other hazards before, during, and after installation.

## **1.8 PROJECT CONDITIONS**

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

## **1.9 WARRANTIES**

- A. At project closeout, provide to OWNER an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage. The warranty shall be one (1) year minimum from Date of Substantial Completion.
- B. CONTRACTOR shall assume full responsibility and warrant for one year the satisfactory performance of the total window installation which includes that of the windows, hardware, glass (including insulating units), anchorage and setting system, sealing, flashing, etc., as it relates to air, water, and structural adequacy as called for in the specifications and approved shop drawings.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. General: Aluminum windows shall be single hung, impact resistant, heavy commercial thermally improved windows. Provide impact resistant window assembly meeting either FBC 2007 – HVHZ Protocols; Miami-Dade protocols; or ASTM E1886 and ASTM E1996 (Level D) Protocols.
- B. Aluminum
  - 1. Frame: Extruded aluminum shall be 6063-T5 or T6 alloy and tempered.
  - 2. Ventilator: Extruded tubular aluminum shall be 6063-T5 or T5 alloy and tempered.
- C. Frame: Thermally broken meeting the following requirements.
  - 1. Wall Thickness: 0.062-inches minimum.
  - 2. Depth: 4 inch (nominal).
  - 3. Sill Wall Thickness: 0.090 inches minimum
  - 4. Corners: Closely fit and mechanically fastened with screws. Must be sealed using AAMA approved sealants in a multi-step process to provide sealant redundancy.
  - 5. Leg: Provide equal leg frame.
  - 6. Bevel: The bevel on the perimeter frame must be an integral part of the main frame. Drop in grid will not be accepted.
- D. Ventilator and Access Sash: Thermally broken meeting the following requirements.
  - 1. Vent Frame: Thermally broken.
  - 2. Wall Thickness: 0.080 inches minimum.
  - 3. Corners: Mitered and mechanically fastened with screws. Joinery is sealed with small joint sealant.

4. Each vent shall have two rows of heavy fin wool pile weather stripping and one row of ridged vinyl installed in a specifically designed weather strip pocket for the extrusion.
5. Bevel: Integral bevel on glazing leg or glazing bead

**E. Weatherstrip**

1. Each vent shall have one row of heavy fin wool pile weather stripping and one row of ridged vinyl installed in specifically designed weather strip pockets for the extrusion.

**F. Thermal Barrier**

1. Poured-in-place structural thermal barrier shall transfer during bending and provide composite action between frame components.
2. Thermal barrier pocket on aluminum extrusions shall be Azo-Braded to create a mechanical lock to improve the adhesion properties between the polyurethane polymer and the surface of the thermal barrier pocket.
3. Window manufacturer must provide a warranty from the manufacturer of the polyurethane thermal barrier that warrants against product failure as a result of thermal shrinkage beyond 1/8-inch from each end and fracturing of the polyurethane for a period not to exceed ten years from the date of window manufacture.
4. Thermal barriers made of crimped in place polyamide strips are not acceptable unless all strips are covered and tooled with Dow 795 silicone caulking to climate water migration.

## **2.2 HARDWARE**

A. General: Provide manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash weight and dimensions.

B. Single Hung Windows: Provide the following operating hardware:

1. Sash Balances: A Class 5 adjustable spiral balance with stainless steel or other corrosion-resistant components. Two per sash.
2. Handle: Continuous, integral, bottom sash lift handle.
3. Sash Lock: White bronze sweep lock and keeper on meeting rails. One or two per sash as required by size. Brushed nickel finish.

## **2.3 TRIM AND PANS**

A. Sill Extension: as required to extend sill past the face of the exterior wall. CONTRACTOR to field verify.

B. Pan Head and Jamb: as required to wrap around the face of the exterior wall. CONTRACTOR to field verify.

## **2.4 SCREENS**

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on the outside of

window and provide for each operable exterior sash.

1. Comply with SMA 1004 for minimum standards of appearance, fabrication, attachment of screen fabric, hardware, and accessories unless more stringent requirements are indicated.

B. Frame: Extruded aluminum, 6063-T6 alloy and temper.

1. Screen mounting holes shall be pre-drilled at the factory.

C. Screen Fabric: 0.011-inch diameter 5154 alloy wire woven in 18 x 16 mesh.

1. Color: Charcoal anodized.

## 2.5 MULLIONS AND GRIDS

A. Mullion:

1. Thermal Mullion

B. Stack: Horizontal

C. Non-Removable Grid Frames:

1. Integral Bevel

## 2.6 FABRICATION

A. Glazing

1. Glazing: All units shall be factory glazed with butyl tape, silicone cap bead on the exterior, with glazing vinyl and extruded snap-in aluminum glazing bead on the interior.
2. Glass Type: Impact Resistant per the following requirements.
  - a. Laminated Glass for Large Missile Impact (LMI) Windows: 1/4-inch heat strengthened outer lite with 0.090-inch Saflex interlayer, and 1/4-inch heat strengthened inner lite or approved equal.
3. Restroom Window shall interior glass shall have an obscured glazing.

B. Finish

1. Anodic Finish: All exposed areas of aluminum windows and components shall receive a two-step finish: clear anodize components, then color coat with electrostatically deposited finish in accordance with Aluminum Association Designation AA-M12-C22-A, color as indicated.
  - a. Color: A44, Class I color anodized at 0.7 mils or greater in accordance with AAMA 611 (Winco Finish - #115 Black)

## 2.7 MANUFACTURER

- A. The windows shall be **Series 8000 by U.S. Aluminum, Series 4410S Impact Resistant Series by Winco Windows Co., Series AA5450 by Kawneer Company, Inc.,** or approved equal.

## **PART 3        EXECUTION**

### **3.1   EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. Verify that openings are dimensionally within allowable tolerances, plumb, level, clean, provide a solid anchoring surface, and are in accordance with approved shop drawings.
- C. If substrate preparation is the responsibility of another installer, notify ENGINEER of unsatisfactory preparation before proceeding.

### **3.2   PREPARATION**

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### **3.3   INSTALLATION**

- A. Install in accordance with manufacturer's instructions.
- B. Use only skilled tradesmen with work done in accordance with approved shop drawings and specifications.
- C. Adequately anchor to maintain positions permanently when subjected to normal thermal movement, specified building movement, and specified wind loads.
- D. Furnish and apply sealants to provide a weather-tight installation at all joints and intersections and at opening perimeters.

### **3.4   PROTECTION**

- A. Protect installed products until completion of the project.
- B. Final operating adjustment shall be made after the glazing work is complete. Operating sash and ventilator shall operate smoothly and shall be weathertight when in locked position
- C. Touch-up, repair or replace damaged products before Substantial Completion.

### **3.5   CLEANING**

- A. After completion of window installation, windows shall be inspected, adjusted, put into working order and left clean, free of labels, dirt, etc. Protection from this point shall be the responsibility of CONTRACTOR.

- END OF SECTION -

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**SECTION 08 62 00**  
**SKYLIGHTS**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section covers all the Work necessary to furnish and install curb mount, double dome, impact resistant skylights, complete and in place.
- B. Refer to roofing system Section(s) for roofing accessories to be built into the roofing system to accommodate the Work of this Section.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 09 90 00 Painting and Finishes

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN ARCHITECTURAL MANUFACTURER'S ASSOCIATION (AAMA)
  - 1. AAMA 1606 Voluntary Uniform Load Structural Standard for Plastic Domed Skylights
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 123 Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products
  - 2. ASTM B 221 Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
  - 3. ASTM D 256 Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
  - 4. ASTM D 4802 Standard Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet

**1.4 PERFORMANCE REQUIREMENTS**

- A. General: Provide unit skylights capable of withstanding loads as prescribed by the prevailing code for the project location and includes the following:
  - 1. Thermal stresses transferred to the building structure.
  - 2. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing.
  - 3. Noise or vibration created by thermal and structural movement and wind.
  - 4. Weakening of fasteners, attachments, and other components.

- B. Structural Loads: Provide unit skylights that meet the requirements of AAMA 1606-82, which requires acrylic thickness adequate to withstand a positive and negative test pressure of 60 PSF.
- C. Unit skylights must be tested and certified by NFRC for thermal performance. Products must be listed in the NFRC Certified Products directory.
- D. System Performance Requirements:
  - 1. Double dome models:
    - a. U-factor shall be 0.61 BTU/HR-ft<sup>2</sup>-F maximum per NFRC 100
    - b. SatinSky2/Clear:
      - 1) SHGC shall be 0.45 maximum per NFRC 200
      - 2) Visible Light Transmission shall be 60% per ASTM E972

## **1.5 SUBMITTALS**

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product Data Sheet: For each type of skylight specified, include details of construction and installation, relative to applicable roofing materials, materials, gauges, sizes, finishes, and fasteners.
- C. Samples for Selection: Manufacturer's color charts showing a full range of colors available for each type of skylight glazing and Aluminum Finish.

## **1.6 DELIVERY AND STORAGE**

- A. Skylights shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon.

## **1.7 WARRANTY**

- A. General: Warranties specified in this section 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. Skylight Warranty: Provide written warranty signed by manufacturer, agreeing to repair or replace work that exhibits defects in materials or workmanship and guaranteeing weather-tight and leak-free performance. "Defects" is defined as uncontrolled leakage of water and abnormal aging or deterioration.
  - 1. Warranty Period: 5 years from date of Substantial Completion.
- C. Plastic Warranty: Provide a written warranty signed by manufacturer agreeing to repair or replace work that has or develops defects in the plastic. "Defects" is defined as abnormal aging or deterioration.
  - 1. Warranty Period for Acrylic: 5 years from date of Substantial Completion.

- D. Finish Warranty: Provide written warranty signed by manufacturer agreeing to repair or replace work with finish defects. "Defects" are defined as peeling, chipping, chalking, fading, abnormal aging or deterioration, and failure to perform as required.

1. Warranty Period for Anodized Finish: 5 years from date of shipment from the manufacturer.

## **PART 2 PRODUCTS**

### **2.1 SKYLIGHTS**

- A. Skylights shall be as noted in the Contract Drawings and be manufactured by **Wasco Skylights (Velux Group), Aladdin Industries**, or approved equal. Skylights shall be factory assembled with square double-dome type designed to meet applicable OSHA and building code requirements. Skylights shall be watertight with curb frame insulation and meet the requirements specified herein. All hardware shall be stainless steel throughout. Skylights shall be provided with a permanent label showing the manufacturer's name and address and the model number.

1. Curb Frame: Bright white high-performance PVC with bronze cap stock and minimum effective thickness of 0.060-inch. Provide an integral condensation gutter system with corners fully welded for waterproof quality.
2. Retainer Frame: Extruded aluminum alloy 6063-T5 (min) conforming to ASTM B 221 with minimum effective thickness of 0.60-inch.
3. Integral Curbs (Where indicated): Fabricated from double skin of 1100-H14 sheet aluminum, insulated with 1-inch fiberglass insulation. Provide thermal break at top and bottom. Provide minimum 0.025-inch minimum thickness inner and outer skin. Outer skin to be 0.032 inch when length exceeds 48 inches.
4. Plastic Sheets: Monolithic, formable, transparent (colorless/tinted) sheets with good weather and impact resistant.
  - a. Impact Modified Acrylic: Conforming to ASTM D 4802, thermoformable, acrylic (methacrylate) impact modified sheets manufactured by the extrusion process, category C-2 or CC-2, type UVA (formulated with ultraviolet absorber) with Finish 1 (smooth or polished). Average impact strength of 0.75 ft-lb/inch (40 J/m of notch) when tested according to ASTM D 256, Test Method A (Izod).
5. Thermal Break: Fabricate skylight units with thermal barrier separating interior metal framing from materials exposed to outside temperature.
6. Shape and Size: As indicated by model number.
7. Gaskets: Structural glazing tape to form adhesive bond between PVC curb and inner dome, between inner and outer dome, and between outer dome and extruded aluminum retainer. Gaskets form an air and water impenetrable barrier between adjacent surfaces.
8. Fasteners: Same material as metals being fastened or non-magnetic stainless steel as recommended by the manufacturer.

B. ALUMINUM FINISHES FOR GLAZING RETAINER

1. General: Comply with NAAMM "Metal Finishes Manual" recommendations for application and designations of finishes.

2. Finish designations prefixed by AA conform to the system for designations of aluminum finishes established by the Aluminum Association.
  - a. Mill Finish: Manufacturer's standard mill finish.

## **2.2 PREFABRICATED CURBS**

- A. Provide and install a thermally enhanced, thermally broken aluminum curb, if indicated on the Contract Drawings. Curb shall have 1-1/2-inch-thick rigid insulation with an R-value of 5.8 and 2"x2" nailer on top.

## **2.3 SKYLIGHT SCREENS**

- A. All skylights that do not meet OSHA and building code requirements for opening protection shall be provided with skylight screens. Screens shall be designed to meet OSHA regulation 29 CFR 910.23(e)(8) and shall meet the code requirements for opening protection. The entire assembly and anchoring system shall be designed and tested to withstand a minimum impact load of 300-foot pounds.
- B. Screens shall be hot-dip galvanized, 3-inch by 4-inch welded wire mesh with a minimum diameter of 0.195-inch. Galvanizing shall conform to ASTM A 123.
- C. Screens shall be manufactured by **Wasco Skylights (Velux Group), Aladdin Industries, Plasteco, Inc.**, or approved equal.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions, with installer present, for compliance with requirements for installation tolerances and other conditions affecting skylight performance.
  1. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Skylights shall be installed in accordance with approved detail drawings and manufacturers' instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, skylights shall be weather tight and shall be free from warp, twist, or distortion.
- B. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape as recommended by the manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by the manufacturer.
- C. Coordinate with installation of the roof deck and other substrates to receive skylights. Coordinate vapor barriers, roof insulation, roofing material, and flashing as required to assure that each element of the work performs properly and that combined elements were waterproof and watertight. Anchor units securely to supporting structure substrates

to adequately withstand lateral and thermal stresses as well as inward and outward loading pressures.

- D. Where counter flashing is required as a component of the skylight, install to provide adequate waterproof overlap with roofing or roof flashing. Seal with a thick bead of mastic sealant, except where overlap is indicated to be left open for ventilation.

### **3.3 CLEANING AND PROTECTION**

- A. Clean exposed metal and plastic surfaces according to manufacturer's instructions. Touch up damaged metal coatings.
- B. Final cleaning by CONTRACTOR.

- END OF SECTION -

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**SECTION 09 90 00**  
**PAINTING AND FINISHES**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This section covers furnishing, surface preparation, and applying paints and coatings, complete and in place, to all specified surfaces including exposed valves, piping, or fittings.
- B. Definitions
  - 1. The term "paint", "coatings", or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, and other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat.
  - 2. The term "DFT" means minimum dry film thickness, without any negative tolerance.
  - 3. The term "mil" means thousandths of an inch.
  - 4. The term "SSPC" means The Society for Protective Coatings.
- C. The following surfaces shall not be coated:
  - 1. Concrete, unless required by items on the concrete coating schedule below or the Contract Drawings.
  - 2. Stainless steel
  - 3. Machined surfaces
  - 4. Grease fittings
  - 5. Glass
  - 6. Equipment nameplates
  - 7. Platform gratings, stair treads, door thresholds, and other walk surfaces, unless specifically indicated to be coated.
- D. The protective coatings applicator (Applicator) shall possess a valid state license as required for the performance of the painting and coating work called for in this specification and shall provide 5 references which show the Applicator has previous successful experience with the indicated of comparable coating systems. Include the name, address, and the telephone number for the owner of each installation for which the Applicator provided the protective coating.

**1.2 RELATED WORK**

- A. Related Work in other Sections includes, but is not limit to:
  - 1. Section 01 33 00                      Submittal Procedures
  - 2. Section 03 30 00                      Cast-in-Place Concrete
  - 3. Section 05 50 00                      Miscellaneous Specialties
  - 4. Section 08 10 00                      Doors, Frames, and Hardware
  - 5. Section 33 05 05                      Ductile Iron Pipe
  - 6. Section 33 11 10                      Miscellaneous Appurtenances

### 1.3 REFERENCES AND STANDARDS

A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract:

1. OSHA Occupation Safety and Health Act: State of Utah and Federal
2. ICRI International Concrete Repair Institute Guideline No. 310.2 –  
Selecting and Specifying Concrete Surface Preparation for  
Sealers, Coatings, and Polymer Overlays

B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI A 13.1 Standard for Scheme for the Identification of Piping Systems
2. ANSI Z 535 Standard for Safety Colors

C. AMERICAN SOCIETY OF TESTING AND MATERIALS (ASTM)

1. ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
2. ASTM D 520 Standard Specification for Zinc Dust Pigment
3. ASTM D 521 Standard Test Methods for Chemical Analysis of Zinc Dust (Metallic Zinc Powder)
4. ASTM D 6943 Standard Practice for Immersion Testing of Industrial Protective Coatings Linings
5. ASTM D 1653 Standard Test Methods for Water Vapor Transmission of Organic Coating Films
6. ASTM D 2370 Standard Test Method for Tensile Properties of Organic Coatings
7. ASTM D 2794 Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)
8. ASTM D 4263 Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method
9. ASTM D 4414 Standard Practice for Measurement of Wet Film Thickness by Notch Gages
10. ASTM D 4417 Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel
11. ASTM D 7234 Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers
12. ASTM D 7682 Standard Test Method for Replication and Measurement of Concrete Surface Profiles Using Replica Putty
13. ASTM E 96 Standard Test Methods for Water Vapor Transmission of Materials
14. ASTM F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
15. ASTM F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 210 Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
2. AWWA C 222 Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings



E. AMERICAN CONCRETE INSTITUTE (ACI)

1. ACI 301                      Specifications for Structural Concrete

F. NACE International (NACE)

1. NACE RP0287      Field Measurement of Surface Profile of Abrasive Blast-Cleaned Steel Surfaces Using a Replica Tape
2. NACE SP0188      Standard Practice for Discontinuity (Holiday) Testing of Protective Linings
3. NACE SP0892      Standard Practice for Coatings and Linings over Concrete for Chemical Immersion and Containment Service
4. NACE No. 1/SSPC-SP 5 White Metal Blast Cleaning
5. NACE No. 2/SSPC-SP10 Near White Metal Blast Cleaning
6. NACE No. 3/SSPC-SP6 Commercial Blast Cleaning
7. NACE No. 6/SSPC-SP13 Surface Preparation of Concrete

G. SSPC: The Society for Protective Coatings (SSPC)

1. SSPC PA1 - Shop, Field, and Maintenance Painting of Steel
2. SSPC-PA2 – Paint Application Specification No. 2: Measurement of Dry Coating Thickness with Magnetic Gages.
3. SSPC-PA11 - Protecting Edges, Crevices, and Irregular Steel Surfaces by Stripe Coating
4. SSPC-SP 6/NACE No. 3 - Commercial Blast Cleaning.
5. SSPC-SP10/NACE 2 - Near White Metal Blast Cleaning
6. SSPC-SP16 – Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
7. SSPC-VIS 1 - Guide to Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning

H. NSF INTERNATIONAL (NSF)

1. NSF/ANSI 61      Drinking Water System Components – Health Effects
2. NSF/ANSI 600      Health Effects Evaluation and Criteria for Chemicals in Drinking Water

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall supply shop drawings for approval on all paint materials at least 30 days prior to installation. Submittals shall include the following data sheets:
  1. For each paint system used herein, furnish a Paint System Data Sheet (PSDS), Technical Data Sheets, and paint colors available (where applicable) for each product used in the paint system, except for products applied by equipment manufacturers.
- C. Where NSF/ANSI 61 and/or NSF/ANSI 600 approval is required, submit ANSI/NSF 61/600 certification letter for each coating in the system indicating the product application limits on size of tank or piping, dry film thickness, number of coats, specific product tests, colors certified, and approved additives.

D. Quality Control Submittals:

1. Furnish a list of references for the Applicator substantiating the requirements as specified.
2. Manufacturer's certification stating factory applied coating systems meets or exceeds requirements specified herein.
3. If the manufacturer of finish coating differs from that of shop primer, provide both manufacturers' written confirmation that materials are compatible.

**1.5 PAINT DELIVERY, STORAGE, AND HANDLING**

- A. Deliver paint to the project site in unopened containers that plainly show, at the time of use, the designated name, date of manufacture, color, and name of manufacturer.
- B. Store paints in a suitable protected area that is heated or cooled as required to maintain temperatures within the range recommended by the manufacturer.

**1.6 QUALITY ASSURANCE**

- A. All inspection for quality assurance shall ultimately be the responsibility of CONTRACTOR. OWNER retains the right to observe, accept, or reject the work based on the results of CONTRACTOR's inspection or observations by ENGINEER, at OWNER's discretion, in accordance with the Specifications.
- B. Repair and recoat all runs, overspray, roughness, or any other signs of improper application in accordance with paint manufacturer's instructions and as reviewed by ENGINEER.
- C. Observations by OWNER or ENGINEER, or the waiver of inspection of any particular portion of the work, shall not be construed to relieve CONTRACTOR of his responsibility to perform the work in accordance with these Specifications.

**1.7 MANUFACTURER'S SERVICES**

- A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

**1.8 SPECIAL CORRECTION OF DEFECTS REQUIREMENTS**

- A. An inspection may be conducted during the eleventh month following completion of coating work. CONTRACTOR and a representative of the coating material manufacturer shall attend this inspection. Defective work shall be repaired in accordance with these specifications and to the satisfaction of OWNER. OWNER may, by written notice to CONTRACTOR, reschedule the inspection to another date within the one-year correction period or may cancel the inspection altogether. CONTRACTOR is not relieved of its responsibilities to correct defects whether or not the inspection is conducted.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. CONTRACTOR shall use suitable coating materials as recommended by the manufacturer. Materials shall comply with Volatile Organic Compound (VOC) limits applicable at the Site.
- B. Where manufacturers and product numbers are listed, it is to show the type and quality of coatings that are required. If a named product does not comply with VOC limits in effect at the time of Bid opening, that product will not be accepted, and CONTRACTOR shall propose a substitute product of equal quality that does comply. Proposed substitute materials will be considered as indicated below. Coating materials shall be materials that have a record of satisfactory performance in industrial plants, manufacturing facilities, and water and wastewater treatment plants.
- C. In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to the compatibility of primers and finish coats. If necessary, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- D. Colors and shades of colors of coatings shall be as indicated or selected by ENGINEER. Each coat shall be of a slightly different shade to facilitate observation of surface coverage of each coat. Finish colors shall be as selected from the manufacturer's standard color samples by OWNER.
- E. Substitute or "Or-Equal" Products
  - 1. Basis of Design: The Coating Systems listed below in paragraph 2.3 are based on products from Tnemec Company Incorporated, except where indicated below.
  - 2. Product Substitution: To establish equality under Section 01 60 00 – Product Requirements, the specified coating systems are the minimum standard of quality for this project. Equivalent materials of other manufacturers may be substituted only by approval of ENGINEER. Requests for material substitutions shall be in accordance with the requirements of the project specification.
  - 3. Product Requirements: CONTRACTOR shall furnish satisfactory documentation from the manufacturer of the proposed substitute or "or equal" product that the material meets the indicated requirements and is equivalent or better in the following properties: Quality, Durability, Resistance to abrasion and physical damage, Life expectancy, Ability to recoat in the future, Solids content by volume, Dry film thickness per coat, Compatibility with other coatings, Suitability to chemical attack, Temperature limitations during application and in service, Type and quality of recommended undercoats or topcoats, Ease of repairing damaged areas, and stability of colors.
  - 4. Manufacturers of "or equal" products shall provide direct performance comparison with the materials specified, in addition to complying with all other requirements of these Specifications. "Or equal" products shall employ the same generic type materials and system components as the specified coating systems.
  - 5. Requests for product substitution shall be made and approved at least 10 days prior to bid date.
  - 6. CONTRACTOR shall bear any additional costs, if a proposed substitution requires changes or additional work.

## 2.2 COLORS

- A. Provide colors as selected by OWNER or ENGINEER.
- B. Colors shall be formulated with colorants free of lead, lead compounds, or other materials which might be affected by the presence of hydrogen sulfide or other gas likely to be present at the project.
- C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply color matches.
- D. Equipment colors;
  - 1. Equipment shall mean the machinery or vessel itself plus the structural supports and fasteners.
  - 2. Paint non-submerged portions of equipment in the same color as the process piping it serves, except as indicated below:
    - a. Dangerous parts of equipment and machinery: OSHA Orange
    - b. Fire protection equipment and apparatus: OSHA Red
    - c. Radiation hazards: OSHA Purple
    - d. Physical hazards in normal operating area: OSHA Yellow
  - 3. Fiberglass reinforced plastic (FRP) equipment with an integral colored gel coat does not require painting, provided the color is as specified.
- E. Piping color coding shall be in accordance with ANSI A13.1, Division of Drinking Water R-309-525, and International Plumbing Code.
  - 1. Color code non-submerged metal piping except electrical conduit. Paint fittings and valves the same color as the pipe unless otherwise specified.
  - 2. Pipe supports: If pipe supports are not galvanized or stainless steel, supports shall be painted ANSI No. 70 light gray as specified in ANSI Z535.
  - 3. Fiberglass reinforced plastic (FRP) pipe and polyvinyl chloride (PVC) pipe located outside of buildings and enclosed structures will not require painting, unless noted otherwise on the Contract Drawings.

## 2.3 COATING SYSTEMS

- A. System No. 1A Steel Pipe Lining (Not Used)
- B. System No. 1B Steel Coating (Not Used)

C. System No. 3 Steel – Interior Exposed

1. Materials

Type	Polyamide Epoxy
VOC content, max, g/L	250
Volume Solids, min, %	67
Demonstrated Suitable for	Ferrous, galvanized, surfaces in industrial exposure, resistant to mild corrosion and chemical fumes, has good color and gloss retention
Certification	None

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Ferrous Metal: SSPC-SP6 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils  Galvanized and Non-Ferrous: SSPC-SP16 with a minimum angular anchor profile of 1.5 mils	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 69 Hi-Build Epoxoline II	Primer: 3-5 DFT Finish: 4-6 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams Macropoxy 646 Fast Cure Epoxy	
	Primer: Carboline Carboguard 60 Finish: Carboline Carboguard 60	

3. Application

- a. All exposed metal surfaces located inside of structures.

4. Special Requirements

- a. The surface preparation and primer shall be shop applied to all surfaces prior to installation. Finish coats need only be applied to the surfaces exposed after completion of construction.

D. System No. 4 Steel – Exterior Exposed

1. Materials

Type	Zinc-Rich primer with Polyamide Epoxy (intermediate coat), and Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	340 Zinc Primer 300 Intermediate and Finish Coats
Demonstrated Suitable for	Ferrous, galvanized, surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering
Certification	Primer shall be SSPC Paint 20, Type II and meet requirements for ASTM 520 Type III or ASTM 521

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP6 Commercial Blast Cleaning with a minimum angular anchor profile of 1.5 mils	Primer: Tnemec Series 90-97 Tneme-Zinc Intermediate: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 1095 Endura-Shield	Primer: 2.5-3.5 DFT Intermediate: 4-6 DFT Finish: 3-5 DFT
	Primer: Sherwin Williams Zinc Clad III HS Intermediate: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams Hi-Solids Polyurethane 250	
	Primer: Carboline Carbozinc 859 Intermediate: Carboline Carboguard 60 Finish: Carboline Carbothane 134VOC(Gloss) or 133LV(Satin)	

3. Application

- a. All exposed steel surfaces located outside of structures.

4. Special Requirements

- a. The surface preparation and primer shall be shop applied to all surfaces prior to installation. Finish coats need only be applied to the surfaces exposed after completion of construction.

E. System No. 5 Buried Steel Pipe (Not Used)

F. System No. 6 Steel – Doors and Frames

1. Materials

Type	High-Build Epoxy with Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	250
Demonstrated Suitable for	Interior and Exterior Industrial, Architectural, and Commercial applications

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP2/SP3 Hand and Power Tool Cleaning; feather rough edges; remove loose rust, dirt, and other contaminants with sandpaper	Primer: Tnemec Series 135 Chem-Build Finish: Tnemec Series 1095 Endura-Shield	Primer: 3-5 DFT Finish: 3-5 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams HS Polyurethane 250	
	Primer: Carboline Carboguard 60 Finish: Carboline Carbothane 133LV(Satin) or 134VOC(Gloss)	

3. Application

- Factory primed steel doors and frames
- Exterior and Interior steel in corrosive and non-immersion environments.
- Maintenance of existing marginally prepared rusty steel and tightly adhering old coatings.

G. System No. 7 Galvanized Steel and Cast/Ductile Iron – Exterior Exposed

1. Materials

Type	Polyamide Epoxy with Aliphatic Acrylic Polyurethane (topcoat)
VOC content, max, g/L	250
Demonstrated Suitable for	Ferrous, galvanized, nonferrous, cast/ductile iron surfaces in industrial exposure, highly resistant to abrasion, wet conditions, corrosive fumes, and exterior weathering

## 2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
<p>Galvanized Steel and Non-Ferrous: SSPC-SP16 brush-off blast cleaning of coated and uncoated galvanized steel and non-ferrous metals to achieve a uniform anchor profile of 1.0-2.0 mils.</p> <p>Ductile and Cast Iron: Prepare all surfaces as per NAPF 500-03 - Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.</p>	<p>Primer: Tnemec Series 69 Hi-Build Epoxoline II</p> <p>Finish: Tnemec Series 1095 Endura-Shield</p>	<p>Primer: 3-5 DFT</p> <p>Finish: 2.5-4 DFT</p>
	<p>Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy</p> <p>Finish: Sherwin Williams Hi-Solids Polyurethane 250</p>	
	<p>Primer: Carboline Carboguard 890</p> <p>Finish: Carboline Carbothane 133LV(Satin) or 134VOC(Gloss)</p>	

## 3. Application

- a. Exposed galvanized and cast/ductile iron surfaces located outside of structures requiring painting and the following specific surfaces unless noted otherwise:
  - 1) All exposed galvanized pipe
  - 2) All exposed cast/ductile iron pipe

## H. System No. 8 Galvanized Steel and Cast/Ductile Iron – Interior Exposed

### 1. Materials

Type	Polyamide Epoxy
VOC content, max, g/L	250
Demonstrated Suitable for	Ferrous, galvanized, nonferrous, cast/ductile iron surfaces in industrial exposure, resistant to mild corrosion and chemical fumes, has good color and gloss retention



## 2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Galvanized Steel and Non-Ferrous: SSPC-SP16 brush-off blast cleaning of coated and uncoated galvanized steel and non-ferrous metals to achieve a uniform anchor profile of 1.0-2.0 mils. Ductile and Cast Iron: Prepare all surfaces as per NAPF 500-03 - Uniformly abrasive blast the entire exterior surface using abrasive to an NAPF 500-03-04 with a minimum angular anchor profile of 1.5 mils.	Primer: Tnemec Series 69 Hi-Build Epoxoline II Finish: Tnemec Series 69 Hi-Build Epoxoline II	Primer: 3-5 DFT Finish: 3 – 5 DFT
	Primer: Sherwin Williams Macropoxy 646 Fast Cure Epoxy Finish: Sherwin Williams Macropoxy 646 Fast Cure Epoxy	
	Primer: Carboline Carboguard 60 Finish: Carboline Carboguard 60	

## 3. Application

- a. Exposed galvanized and cast/ductile iron surfaces located inside of structures requiring painting and the following specific surfaces unless noted otherwise:
  - 1) All exposed galvanized pipe
  - 2) All exposed cast/ductile iron pipe
- b. Do not paint galvanized steel mechanical pipe and equipment supports unless noted otherwise.

### I. System No. 9 Concrete Floors – Light Traffic, Low Impact

#### 1. Materials

Type	Modified Polyamine Epoxy
VOC content, max, g/L	75
Demonstrated Suitable for	Concrete floors providing protection against various acids and alkalis and frequent cleaning

## 2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
SSPC-SP13 Concrete Surface Preparation, ICRI CSP 2-4	Primer: Tnemec Series 201 Epoxoprime Intermediate: Tnemec Series 281 Tneme-Glaze Finish: Tnemec Series 281 Tneme-Glaze	Primer: 6-8 DFT Intermediate: 6-8 DFT Finish: 6-8 DFT
	Primer: Sherwin Williams Resuprime 3579 Intermediate: Sherwin Williams Resuflor 3746 HP Epoxy Finish: Sherwin Williams Resuflor 3746 HP Epoxy	
	Primer: Carboseal 720 Intermediate: Carboline Carboseal 745 Finish: Carboline Carboseal 745	

## 3. Application

- a. Concrete floors not exposed to wastewater or chemicals unless noted otherwise.

J. System No. 10 Concrete Floors (Not Used)

K. System No. 11 – Gypsum Wallboard and Plaster

## 1. Materials

Type	Waterborne Epoxy/Acrylic Polymer
VOC content, max, g/L	175/94
Demonstrated Suitable for	long term protection in both interior/exterior exposures

## 2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Sand joint compound smooth and feather edge. Clean and dry.	Primer: Tnemec Elasto-Grip FC Series 151-1051 Intermediate: Tnemec Enduratone Series 1028 Finish: Tnemec Enduratone Series 1028	Primer: 0.7-1.5 DFT Intermediate: 2-3 DFT Finish: 2-3 DFT
	Primer: Sherwin Williams Multi-purpose Interior-Exterior Latex Primer-Sealer Intermediate: Sherwin Williams Pro Industrial High-Performance Acrylic Finish: Sherwin Williams Pro Industrial Performance Acrylic	
	Primer: Carboline Sanitile 120 Intermediate: Carboline Carbocrylic 3359 Finish: Carboline Carbocrylic 3359	

## 3. Application

- a. Interior gypsum wallboard and plaster on walls and ceilings.

## L. System No. 12 – Concrete Walls and Concrete Masonry Units, Interior – Not Exposed to Chemicals

### 1. Materials

Type	Latex Filler/Water Based Acrylic Epoxy
VOC content, max, g/L	<60/244
Demonstrated Suitable for	long term protection for interior exposures

### 2. Coating System

Products	Total System (mils)
Filler: Tnemec Series 54 Intermediate: Tnemec H.B. Tnemec-Tufcoat Series 113 Finish: Tnemec H.B. Tnemec-Tufcoat Series 113	Surfacer/Filler Intermediate: 4-6 DFT Finish: 4-6 DFT
Filler: Sherwin-Williams Pro Industrial Heavy Duty Blockfiller Finish: Sherwin-Williams Waterbased Catalyzed Epoxy B73-300 Series	

3. Surface preparation
  - a. Surface cracks, holes, or other imperfections in concrete surfaces only that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
  - b. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
  - c. Scrub and rinse surfaces with water, and let dry.
  - d. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
  - e. Concrete shall cure a minimum of 28 days before application.
  - f. Apply coating per manufacturer's recommendations and instructions.
4. Application
  - a. Interior concrete and concrete masonry unit walls not subject to splashing from wastewater and/or chemicals.

M. System No. 13 Concrete Walls and Concrete Masonry Units, Interior (Not Used)

N. System No. 14 Concrete Exposed to Severe Wastewater (Not Used)

O. System No. 15 Wood, Interior Exposed

1. Materials

Type	Acrylic
VOC content, max, g/L	50
Demonstrated Suitable for	Wood trim and plywood sheathing in pump stations and similar municipal water and wastewater facilities.

2. Surface preparation and Coating System

Surface Preparation	Products	Total System (mils)
Surface Preparation: Sand rough areas, Clean and Dry	Primer: Sherwin Williams Multi-purpose Interior-Exterior Latex Primer-Sealer Intermediate: Sherwin Williams Pro-Industrial Acrylic Coating Finish: Sherwin Williams Pro-Industrial Acrylic Coating	Primer: 0.7-1.5 DFT Intermediate: 2-3 DFT Finish: 2-3 DFT
	Primer: Tnemec Series 51-1051 Elasto-Grip Intermediate: Tnemec Series 1026 EnduraTone Finish: Tnemec Series 1026 EnduraTone	

3. Application
  - a. Trim and plywood sheathing

## 2.4 SPECIAL COATING SYSTEMS

- A. System 200 - PVC Tape: Prior to wrapping the pipe with PVC tape, the pipe and fittings first shall be primed using a primer recommended by the PVC tape manufacturer. After being primed, the pipe shall be wrapped with a 20-mil adhesive PVC tape, half-lapped, to a total thickness of 40 mils. PVC Tape wrap buried pipe where indicated on the Contract Drawings.
- B. System 201 – Water Retardant, Concrete and Masonry

### 1. Materials and Coating System

Type	Silane-modified siloxane
Demonstrated suitable for	Repelling water from vertical concrete and masonry surfaces
VOC Content, g/L, max	250
Products, or approved equal	TAMMS Barracade M.E./9 Rainguard Blok-Lok Tnemec Dur A Pell 20 Series 636 Sherwin Williams Cemlack Concrete Sealer

### 2. Preparation

- Surface cracks, holes, or other imperfections in concrete surfaces only that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
- Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
- Scrub and rinse surfaces with water, and let dry.
- Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
- Concrete shall cure a minimum of 28 days before application.
- Apply coating per manufacturer's recommendations and instructions.

### 3. Application

- Exterior concrete walls of pump station

- C. System 202 – Polyethylene Encasement: Application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C. Provide polyethylene encasement where indicated on the Contract Drawings or per Section 30 05 05 – Ductile Iron Pipe.
- D. System 203 - Cement Mortar Coating (Not Used)

E. System 205 – Anti-Graffiti Coating, Concrete and Masonry

1. Materials and Coating System

Type	Siloxane or Silicone
Demonstrated suitable for	Graffiti resistance on concrete and masonry surfaces and excellent cleanability.
VOC Content, g/L, max	250
Products, or approved equal	Sherwin-Williams Anti-Graffiti Coating Tnemec Dur A Pell GS Series V626

2. Preparation

- a. Surface cracks, holes, or other imperfections in concrete surfaces only that exceed 1/64 of an inch shall be filled with pointing mortar. Masonry joints found to be unsound, hollow, or otherwise defective shall be raked out to a depth of 1/2 inch and pointed with mortar.
- b. Remove loose particles and foreign matter. Remove oil or foreign substance with a cleaning agent which will not affect the coating.
- c. Surfaces shall be clean and dry.
- d. Surface preparation per SSPC-SP13/NACE 6.
- e. Protect adjacent surfaces not scheduled to receive coating and landscaping, property and vehicles from over spray and drift.
- f. Concrete and mortar shall cure a minimum of 28 days before application.
- g. Apply coating per manufacturer's recommendations and instructions.
- h. Coating dry film thickness to be 6.0 to 9.0 mils.

3. Application

- a. Exterior masonry block walls and pilasters.

**2.5 CONCRETE FINISHES**

- A. Exterior Above Grade Concrete: Concrete surfaces exposed to view outside the building and including 6 inches below finished grade on the building or structure should be finished with a "Class B" finish. Products for the "Class B" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- B. Interior Exposed Above Floor Concrete: Interior above grade concrete shall be finished with a "Class B" finish. Products for the "Class B" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- C. Interior Concrete Floors: Interior concrete floors shall be finished with a "Trowel" finish. Products for the "Trowel" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.
- D. Exterior Concrete Flat Surfaces: Exterior concrete flat surfaces shall be finished with a "Broom" finish. Products for the "Broom" finish are identified or specified in Section 03 30 00 - Cast-In-Place Concrete.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. The intention of this specification is for all new, interior and exterior, masonry, concrete, and metal, whether atmospheric or submerged exposure surfaces to be painted whether specifically mentioned or not, except as modified herein. Concealed structural steel surfaces shall receive a prime coat only unless modified herein.
- B. Surface preparation and coating application shall be in accordance with these specifications and the coating manufacturer's written product data sheets and written recommendations of the manufacturer's technical representative. Where conflict occurs between the manufacturer's recommendations and these specifications, the more stringent of the two shall apply unless approved by ENGINEER.
- C. For immersion coatings, obtain full cure for completed system before immersing or allowing exposure to water of condensation for more than 12 hours.

### **3.2 REGULATORY REQUIREMENTS**

- A. Meet federal, state, and local requirements limiting the emission of volatile organic compounds and worker exposures.
- B. Protect workers and comply with applicable federal, state, and local air pollution and environmental regulations for surface preparation, blast cleaning, disposition of spent aggregate and debris, coating application, and dust prevention including but not limited to the following Acts, Regulations, Standards, and Guidelines:
  - 1. Clean Air Act
  - 2. National Ambient Air Quality Standard
  - 3. Resource Conservation and Recovery Act (RCRA)
  - 4. SSPC Guide 6
- C. Comply with applicable federal, state, and local regulations for confined space entry.
- D. Provide and operate equipment that meets explosion proof requirements.

### **3.3 ENVIRONMENTAL CONDITIONS**

- A. Do not apply paint in extreme heat, temperatures below 40 degrees F, nor in dust, smoke-laden atmosphere, damp or humid weather. The Applicator shall adhere to the manufacturer's recommendations regarding environmental conditions. The Applicator shall monitor humidity, air temperature, and surface temperature with properly calibrated instruments.
- B. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, nor whenever surface temperature is less than 5 degrees F above dew point of ambient air. Strictly adhere to manufacturer's recommendations.
- C. Surface preparation power tools and blast equipment shall contain dust collection devices that will prevent discharge of dust particles into the atmosphere around electrical or mechanical equipment unless otherwise permitted by ENGINEER.

- D. Where weather conditions or project requirement dictate, the Applicator shall provide and operate dehumidification equipment to maintain environmental conditions suitable for abrasive blasting and coating application as specified.

### **3.4 WORKMANSHIP**

- A. Skilled craftsmen and experienced supervision shall be used on coating work.
- B. Coating shall be done in a workmanlike manner so as to produce an even film of uniform thickness. Edges, corners, crevices, and joints shall receive special attention to insure thorough surface preparation. The finished surfaces shall be free from runs, drops, ridges, waves, laps, brush marks, and variations in color, texture, and finish. The hiding shall be so complete that the addition of another coat would not increase the hiding. Special attention shall be given so that edges, corners, crevices, welds, and similar areas receive a film thickness equivalent to adjacent areas, and installations shall be protected by the use of drop cloths or other precautionary measures.
- C. Damage to other surfaces resulting from the work shall be cleaned, repaired, and refinished to original condition.

### **3.5 STORAGE, MIXING, AND THINNING OF MATERIALS**

- A. Unless otherwise indicated, the coating manufacturer's printed recommendations and instructions for thinning, mixing, handling, applying, and protecting its coating materials, for preparation of surfaces for coating, and for other procedures relative to coating shall be strictly observed.
- B. Coating materials shall be used within the manufacturer's recommended shelf life.
- C. Coating materials shall be stored under the conditions recommended by the Product Data Sheets, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings from different manufacturers shall not be mixed together.

### **3.6 SURFACE PREPARATION**

- A. All surfaces which receive paint or other coatings shall be prepared in accordance with the recommendations of the manufacturer of the material being used. The Applicator shall examine surfaces to be coated and shall correct surface defects before application of any coating material. Marred or abraded spots on shop-primed and on factory-finished surfaces shall receive touch-up restoration prior to any field coating application.
- B. Perform sandblasting for piping and any other items and equipment where specified and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, and procedures shall meet requirements of the Society for Protective Coatings (formerly the Steel Structures Painting Council).

### **3.7 PROTECTION OF MATERIALS NOT TO BE PAINTED**

- A. Surfaces that are not to receive coatings shall be protected during surface preparation, cleaning, and coating operations.



- B. Remove, mask or otherwise protect hardware, lighting fixtures, switch plates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not intended to be painted.
- C. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.
- D. Protect working parts or mechanical and electrical equipment and motors from damage.
- E. Care shall be exercised not to damage adjacent work during blasting operations. Spraying shall be conducted under carefully controlled conditions. CONTRACTOR shall be fully responsible for and shall promptly repair any and all damage to adjacent work or adjoining property occurring from blasting or coating operations.

### **3.8 SURFACE PREPARATION STANDARDS**

- A. The following referenced surface preparation specifications of the the Society for Protective Coatings shall form a part of this specification:
  - 1. Solvent Cleaning (SSPC SP1): Removal of oil, grease, soil, salts, and other soluble contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam.
  - 2. Hand Tool Cleaning (SSPC SP2): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by hand chipping, scraping, sanding, and wire brushing.
  - 3. Power Tool Cleaning (SSPC SP3): Removal of loose rust, loose mill scale, loose paint, and other loose detrimental foreign matter, by power tool chipping, descaling, sanding, wire brushing, and grinding.
  - 4. White Metal Blast Cleaning (SSPC SP5): Removal of all visible rust, oil, grease, soil, dust, mill scale, paint, oxides, corrosion products and foreign matter by blast cleaning.
  - 5. Commercial Blast Cleaning (SSPC SP6): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 33 percent of each square inch of surface area.
  - 6. Brush-Off Blast Cleaning (SSPC SP7): Removal of all visible oil, grease, soil, dust, loose mill scale, loose rust, and loose paint.
  - 7. Near-White Blast Cleaning (SSPC SP10): Removal of all visible oil, grease, soil, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter, except that staining shall be limited to no more than 5 percent of each square inch of surface area.
  - 8. Surface Preparation of Concrete (SSPC-SP13): Removal of protrusions, laitance and efflorescence, existing coatings, form-release agents, and surface contamination by detergent or steam cleaning, abrasive blasting, water jetting, or impact or power tool methods as appropriate for the condition of the surface and the requirements of the coating system.
  - 9. Surface Preparation (SSPC-SP16): Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals

### **3.9 FERROUS METAL SURFACE PREPARATION (UNGALVANIZED)**

- A. The minimum abrasive blasting surface preparation shall be as indicated in the coating system schedules included at the end of this Section. Where there is a conflict between these requirements and the coating manufacturer's printed recommendations for the intended service, the higher degree of cleaning shall apply.

- B. Oil, grease, welding fluxes, and other surface contaminants shall be removed by solvent cleaning per SSPC SP1 - Solvent Cleaning prior to blast cleaning.
- C. Round or chamfer all sharp edges and grind smooth burrs and surface defects and weld splatter prior to blast cleaning.
- D. Surfaces shall be cleaned of dust and residual particles of the cleaning operation by dry air blast cleaning, vacuuming, or another approved method prior to painting.
- E. Enclosed areas and other areas where dust settling is a problem shall be vacuum cleaned and wiped with a tack cloth.
- F. Damaged or defective coating shall be removed by the blast cleaning to meet the clean surface requirements before recoating.
- G. If the required abrasive blast cleaning will damage adjacent work, the area to be cleaned is less than 100 square feet, and the coated surface will not be submerged in service, then SSPC SP2 or SSPC SP3 may be used as per manufacturers recommendations.
- H. Shop-applied coatings of unknown composition shall be completely removed before the indicated coatings are applied. Valves, castings, ductile or cast iron pipe, and fabricated pipe or equipment shall be examined for the presence of shop-applied temporary coatings. Temporary coatings shall be completely removed by solvent cleaning per SSPC SP1 before the abrasive blast cleaning has been started.
- I. Shop primed equipment shall be solvent-cleaned in the field before finish coats are applied.
- J. Exposed ductile iron pipe shall be given a shop coat of rust-inhibitive primer conforming to these specifications. Abrasive blasting of the asphaltic coating on ductile iron pipe will not be allowed.

### **3.10 FERROUS METAL SURFACE PREPARATION (GALVANIZED)**

- A. Galvanized ferrous metal shall be alkaline cleaned per SSPC SP1 to remove oil, grease, and other contaminants detrimental to adhesion of the protective coating system, followed by blast cleaning per SSPC SP16.
- B. Pretreatment coatings of surfaces shall be in accordance with the printed recommendations of the coating manufacturer.

### **3.11 CONCRETE BLOCK MASONRY SURFACE PREPARATION**

- A. Surface preparation shall not begin until at least 30 Days after the masonry has been placed.
- B. Oil, grease, and form release and curing compounds shall be removed by detergent cleaning per SSPC SP1 before abrasive blast cleaning.
- C. Concrete block masonry surfaces to be coated shall be abrasive blast cleaned to remove existing coatings, laitance, deteriorated concrete, and to roughen the surface equivalent to the surface recommended by manufacturer.

- D. If acid etching is required by the coating application instructions, the treatment shall be made after abrasive blasting. After etching, rinse surfaces with water and test the pH. The pH shall be between neutral and 8.
- E. Surfaces shall be clean and as recommended by the coating manufacturer before coating is started.
- F. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model BD-2100, or equal.

### **3.12 CAST-IN-PLACE CONCRETE SURFACE PREPARATION**

- A. Concrete surfaces to receive protective coating shall be cast with a Smooth Form Finish in accordance with ACI 301. Surfaces shall not be rubbed, sacked, troweled or otherwise finished in any manner that will obscure or cover the parent concrete surface with materials other than materials as specified in this Section.
- B. All surfaces must be clean, dry and free of oil, grease and other contaminants, prior to preparation in accordance with NACE No. 6/SSPC-SP13. Concrete surfaces must be sound and capable of supporting the corrosion protection lining system.
- C. Prepare concrete surfaces in accordance with NACE No. 6/SSPC-SP13 Joint Surface Preparation Standards and ICRI Technical Guidelines. Abrasive blast, shot-blast, water jet or mechanically abrade concrete surfaces to remove laitance, curing compounds, hardeners, sealers, existing coatings, and other contaminants and to provide the recommended ICRI-CSP Profile.
- D. Level or grind concrete substrates to produce a uniform and smooth surface, including removal of sharp edges, ridges, form fins, and other concrete protrusions.
- E. Unless required for proper adhesion, surfaces shall be dry prior to coating. The presence of moisture shall be determined with a moisture detection device such as Delmhorst Model BD-2100, or equal.

### **3.13 SHOP COATING REQUIREMENTS**

- A. Unless otherwise indicated, items of equipment or parts of equipment which are not submerged in service shall be shop-primed and then finish-coated in the field after installation with the indicated or selected color. The methods, materials, application equipment, and other details of shop painting shall comply with this Section. If the shop primer requires topcoating within a specific period of time, the equipment shall be finish coated in the shop and then be touched up after installation.
- B. Items of equipment or parts and surfaces of equipment which are submerged or inside an enclosed hydraulic structure when in service, with the exception of pumps and valves, shall have surface preparation and coating performed in the field.
- C. For certain pieces of equipment, it may be undesirable or impractical to apply finish coatings in the field. Such equipment shall be primed and finish coated in the shop and touched up in the field with the identical material after installation. CONTRACTOR shall require the manufacturer of each such piece of equipment to certify as part of its Shop

Drawings that the surface preparation is in accordance with these specifications. The coating material data sheet shall be submitted with the Shop Drawings for the equipment.

- D. For certain small pieces of equipment, the manufacturer may have a standard coating system that is suitable for the intended service conditions. In such cases, the final determination of suitability will be made during review of the Shop Drawing submittals. Equipment of this type generally includes only indoor equipment such as instruments, small compressors, and chemical metering pumps.
- E. Shop-painted surfaces shall be protected during shipment and handling by suitable provisions including padding, blocking, and the use of canvas or nylon slings. Primed surfaces shall not be exposed to the weather for more than 2 months before being topcoated, or less time if recommended by the coating manufacturer.
- F. CONTRACTOR shall make certain that the shop primers and field topcoats are compatible and meet the requirements of this Section. Copies of applicable coating manufacturer's data sheets shall be submitted with equipment Shop Drawings.
- G. Damage to shop-applied coatings shall be repaired in accordance with this Section and the coating manufacturer's printed instructions.

### **3.14 APPLICATION**

#### **A. General**

- 1. Schedule inspection with ENGINEER in advance for cleaned surfaces and all coats prior to each succeeding coat.
- 2. Apply coatings in accordance with the paint manufacturer's recommendations and these specifications, whichever is more stringent. Allow sufficient time between coats to assure thorough drying of previously applied paint.
- 3. Blast cleaned ferrous metal surfaces shall be painted before any rusting or other deterioration of the surface occurs. Blast cleaning shall be limited to only those surfaces that can be coated in the same day.
- 4. Special attention shall be given to materials that will be joined so closely that proper surface preparation and application are not possible. Such contact surfaces shall be coated prior to assembly or installation.
- 5. Finish coats, including touch-up and damage repair coats shall be applied in a manner that will present a uniform texture and color matched appearance.
- 6. Non-buried steel piping shall be abrasive blast cleaned and primed before installation.
- 7. Finish coats shall be applied after concrete, masonry, and equipment installation is complete, and the working areas are clean and dust free.

### **3.15 CURING OF COATINGS**

- A. CONTRACTOR shall maintain curing conditions in accordance with the conditions recommended by the coating material manufacturer or by this Section, whichever is the most stringent, prior to placing the completed coating system into service.
- B. In the case of enclosed areas, forced air ventilation, using heated air, if necessary, may be required until the coatings have fully cured.

### **3.16 SHOP AND FIELD OBSERVATION AND TESTING**

- A. CONTRACTOR shall give ENGINEER a minimum of 3 Days advance notice of the start of any field surface preparation or coating application, and a minimum of 7 Days advance notice of the start of any surface preparation activity in the shop.
- B. Observation by ENGINEER, or the waiver of inspection of any particular portion of the work, shall not relieve CONTRACTOR of its responsibility to perform the work in accordance with these Specifications.
- C. CONTRACTOR shall furnish inspection devices in good working condition for the detection of holidays and measurement of dry film thicknesses of coatings. Dry-film thickness gauges shall be made available for ENGINEER's use while coating is being done, until final acceptance of such coatings. CONTRACTOR shall furnish the services of a trained operator of the holiday detection devices until the final acceptance of such coatings. Holiday detection devices shall be operated only in the presence of ENGINEER.
- D. CONTRACTOR shall test for continuity (holiday test) all coated surfaces inside reservoirs, other surfaces that will be submerged in water or other liquids, surfaces that are enclosed in a vapor space in such structures, and surfaces coated with any of the submerged and severe service coating systems. Areas that contain discontinuities shall be marked and repaired or recoated in accordance with the coating manufacturers' printed instructions and then be retested.
  - 1. Coatings with thickness exceeding 20-mils total DFT: Pulse-type holiday detector such as Tinker & Rasor Model AP-W, D.E. Stearns Co. Model 14/20, or equal shall be used. The unit shall be adjusted to operate at the voltage required to cause a spark jump across an air gap equal to twice the required coating thickness.
  - 2. Coatings with thickness of 20-mils or less total DFT: Tinker & Rasor Model M1 nondestructive type holiday detector, K-D Bird Dog, or equal shall be used. The unit shall operate at less than 75 volts. For thicknesses between 10- and 20-mils, a nonsudsing type wetting agent, such as Kodak Photo-Flo or equal, shall be added to the water prior to wetting the detector sponge.
- E. On ferrous and non-ferrous the dry film coating thickness shall be measured in accordance with the SSPC PA 2 using a magnetic type dry film thickness gauge such as Mikrotest Model FM, Elcometer Model 111/1EZ, or equal. Each coat shall be tested for the correct thickness. No measurements shall be made until at least 8 hours after application of the coating. On non-ferrous metals and other substrates, the coating thicknesses shall be measured at the time of application using a wet film gauge.
- F. Evaluation of blast cleaned surface preparation will be based upon comparison of the blasted surfaces with the standard samples available from SSPC and NACE, such as using NACE standards TM-01-70 and TM-01-75.
- G. Visually inspect concrete, nonferrous metal, plastic, drywall, and wood surfaces to ensure proper and complete coverage has been attained.

### **3.17 CLEANUP**

- A. Place cloths and waste that might constitute a fire hazard in closed metal containers or destroy at the end of each day.

- B. Upon completion of the work, remove staging, scaffolding, and containers from the site or destroy in a legal manner.
- C. Completely remove paint spots, oil, or stains upon adjacent surfaces and floors and leave entire job clean.
- D. Damages due to overspray on buildings, vehicles, trees, or other surfaces not specified to be painted would be the responsibility of CONTRACTOR.

### **3.18 MANUFACTURER' SERVICES**

- A. Furnish paint manufacturer's representative to visit jobsite at intervals during surface preparation and painting as may be required for product application quality assurance, and to determine compliance with manufacturer's instructions and these specifications, and as may be necessary to resolve field problems attributable to, or associated with, manufacturer's products furnished under this Contract.

- END OF SECTION -

**SECTION 10 28 13**  
**TOILET ACCESSORIES**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall furnish and install toilet accessories, complete and operable, as indicated on the Contract Drawings and in accordance with the Contract Documents.
- B. Toilet accessories specified below as “no equal” are the Salt Lake City standard materials. No substitutions will be accepted on these items.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:

- 1. Section 01 33 00                      Submittal Procedures
- 2. Section 22 10 00                      Plumbing Piping and Specialties

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publication is referred to in the text by basic designation only.
- B. AMERICAN STANDARDS FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM F 446                      Standard Consumer Safety Specification for Grab Bars and Accessories Installed in the Bathing Area
- C. U.S. DEPARTMENT OF JUSTICE – AMERICANS WITH DISABILITIES ACT (ADA)
  - 1. 2010 ADA Standards for Accessible Design

**1.4 COORDINATION**

- A. Coordinate accessory locations with other Work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.
- B. Coordinate delivery of inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
- C. Provide 2x Douglas Fir backing in wood or metal stud framed walls for anchoring accessories.

**1.5 SUBMITTALS**

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Product data for each type of product including materials of construction, dimensions, finishes.

- C. Submit product catalog cut sheets.
- D. Submit anchoring and mounting requirements including cutouts in other Work and substrate preparation requirements.
- E. Provide manufacturer's warranty.

## **1.6 REQUIREMENTS OF REGULATORY AGENCIES**

- A. Furnish and install work per applicable provisions of the 2010 ADA Standards for Accessible Design requirements and other applicable codes, rules, regulations, statutes, and ordinances of authorities having jurisdiction.

## **PART 2 PRODUCTS**

### **2.1 DOUBLE ROLL TOILET TISSUE DISPENSER**

- A. Mounting: Surface mounted
- B. Mounting Base: break resistant plastic
- C. Tissue Dispenser (cover): break resistant plastic with lock. Color shall be Black Pearl.
- D. Operation: Holder accommodates two standard-core toilet tissue rolls for non-controlled delivery.
- E. Capacity: Designed for two standard 4-1/2" to 5-1/2" tissue rolls.
- F. Manufacturer, no equal:
  - 1. San Jamar – R3500TBK

### **2.2 PAPER TOWER DISPENSER**

- A. Mounting: Surface mounted
- B. Minimum towel-dispenser capacity: 8" x 1,000 feet
- C. Material and finish: stainless finish
- D. Manufacturer, no equal:
  - 1. Solaris Paper – LoCor D68001

### **2.3 WALL MOUNTED SOAP DISPENSER**

- A. Description: Body to be plastic. Color shall be black.
- B. Mounting: Vertically oriented, surface mounted.
- C. Capacity: 1,200 mL
- D. Operation: Touch free. ADA compliant.



- E. Locking; escutcheon locks to body with concealed locking mechanism opened with key provided.
- F. Manufacturer, no equal:
  - 1. Waxie – Select No-Touch 380124

## **2.4 GRAB BARS**

- A. Mounting: Flanges with concealed fasteners
- B. Materials:
  - 1. Grab bars: Stainless steel, 18-gauge tubing.
  - 2. Concealed mounting flanges: Stainless steel, 11-gauge to 13-gauge plate.
  - 3. Snap flange covers: Stainless steel, 22-gauge plate.
- C. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
- D. Outside diameter: 1 1/4-inch
- E. Configuration and length: As shown on Contract Drawings.
- F. Manufacturer, or approved equal:
  - 1. Brobrick – 5806 Series
  - 2. Bradley – 832-2 Series
  - 3. American Specialties Inc. – 3700 Series

## **2.5 GLASS MIRROR**

- A. Frame: Stainless-steel angle, heavy gauge with satin finish and galvanized steel back
- B. Corners: Manufacturer's standard
- C. Mirror: No. 1 quality, 1/4-inch select float glass (standard glass): selected for silvering, electrolytically copper-plated by the galvanic process, and guaranteed for 15 years against silver spoilage. All edges protected by plastic filler strips; back is protected by full-size, shock-absorbing, water-resistant, nonabrasive, 3/16-inch polyethylene padding.
- D. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
- E. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
- F. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
- G. Manufacturer, or approved equal:

1. Brobrick – Model 290-2436
2. Bradley – Model 780-2436
3. American Specialties Inc. – Model 0620-2436

## **2.6 TOILET SEAT COVER DISPENSER**

- A. Construction: impact resistant plastic. Color shall be Black.
- B. Mounting: surface mounted
- C. Dispenses 250 single or half fold toilet seat covers or one box
- D. Manufacturer, no equal:
  1. San Jamar – Model TS510TBK

## **2.7 SANITARY NAPKIN DISPOSAL**

- A. Mounting: Surface mounted
- B. Container: Durable, high-impact grey ABS or 22-gauge stainless steel with exposed surfaces in architectural satin finish. Heavy-duty stainless steel piano hinge.
- C. Lid: Durable, high-impact grey ABS or 22-gauge stainless steel with exposed surfaces in architectural satin finish.
- D. Waste Receptacle: Leak-proof, rigid molded polyethylene. Removable for servicing. Capacity: 1-gallon minimum.
- E. Manufacturer, or approved equal:
  1. Brobrick – Model B-5270
  2. Bradley – Model 4781-11
  3. American Specialties Inc. – Model 20852

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install all accessories in accordance with the 2010 ADA Standards for Accessible Design.
- B. Install accessories in accordance with Manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by Manufacturer. Install accessories level, plumb, and firmly anchored in locations and at heights as shown on the Drawings.
- C. Install Grab Bars to withstand a downward load of at least 250 lbf, when tested in accordance with ASTM F 446.

### **3.2 CLEANING**

- A. Remove temporary labels and protective covers.
- B. Clean and polish exposed surfaces in accordance with Manufacturer's written instructions.

### **3.3 ADJUSTING**

- A. Adjust accessories for unencumbered, smooth operation.
- B. Replace damaged or defective items.

- END OF SECTION -

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**SECTION 10 44 00**  
**FIRE PROTECTION SPECIALTIES**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall provide fire protection equipment and appurtenant work, complete and in place, according to the Contract Documents.
- B. If more than one fire extinguisher or other fire protection equipment is required, provide products from a single manufacturer.

**1.2 RELATED WORK**

- A. Related work in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM E 814      Standard Test Method for Fire Tests of Penetration Firestop Systems
- C. NATIONAL FIRE PROTECTION ASSOCIATION PUBLICATIONS (NFPA)
  - 1. NFPA No. 10      Standard for Portable Fire Extinguishers
- D. INTERNATIONAL FIRE CODE (IFC)

**1.4 SUBMITTALS**

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures
- B. Submit manufacturer's literature, installation instructions, and fire protection equipment details.

**PART 2 PRODUCTS**

**2.1 GENERAL**

- A. Fire protection equipment shall comply with the IFC, NFPA Pamphlet No. 10, and the manufacturer's recommendations.

## 2.2 MATERIALS

- A. Fire Extinguisher Designated FE-1: FE-1 fire extinguishers shall be 10 pound minimum capacity, A.B.C. dry-chemical type, with minimum UL rating of 4A:80BC.
- B. Fire Extinguisher Designated FE-2: FE-2 fire extinguishers shall be 20 pound minimum capacity, A.B.C. dry-chemical type, with minimum UL rating of 20A:120BC.
- C. Fire Extinguisher Designated FE-3: FE-3 fire extinguishers shall be 10 pound minimum capacity, carbon dioxide type, with minimum UL rating of 10B:C.
- D. Fire Extinguisher Designated FE-4: FE-4 fire extinguishers shall be 5 pound minimum capacity, A.B.C. dry-chemical type, with minimum UL rating of 2A:10BC.
- E. Fire Extinguisher Cabinet (FEC) shall be semi-recessed stainless steel cabinet with stainless steel door and frame, and projecting, convex, butyrate plastic, canopy type viewing door cover. The size shall be as necessary to hold the fire extinguisher indicated at the cabinet location. Fire-rated cabinets conforming to ASTM E 814 shall be used in fire-rated walls.
- F. Mounting brackets shall be specially designed for fire extinguisher.
- G. Other materials not specifically shown on the Contract Drawings or listed in the specifications but required for a complete and proper installation shall be as selected by CONTRACTOR, subject to approval by ENGINEER.
- H. Fire protection equipment shall be manufactured by **Larsen's Manufacturing, Amerex Corporation, Potter-Roemer**, or approved equal.

## PART 3 EXECUTION

### 3.1 DELIVERY AND STORAGE

- A. Fire protection equipment shall be delivered to the site in unbroken packages or containers bearing the manufacturer's label with product description and rating.
- B. Products shall be carefully stored in an area that is protected from deleterious elements as recommended by the manufacturer. Storage shall be in a manner that will prevent damage to the material and finish of the equipment.

### 3.2 INSTALLATION

- A. All equipment shall be mounted and installed as per NFPA Pamphlet No. 10 and the manufacturer recommendations unless otherwise directed by the Fire Marshall. Coordinate final location and mounting heights with the fire Marshall prior to installation.
- B. Fire extinguishers shall be provided with and installed on brackets or brackets within cabinets. CONTRACTOR shall provide blocking and other reinforcing in walls to support the fire extinguishers.

- END OF SECTION -

**SECTION 22 10 10**  
**PLUMBING PIPING AND SPECIALTIES**

**PART 1 GENERAL**

**1.1 SECTION INCLUDES**

- A. CONTRACTOR shall furnish and install plumbing piping and specialties, complete and operable, as indicated in the Contract Drawings and in accordance with the Contract Documents.
- B. Plumbing piping and specialties includes piping, pipe hangers, sleeves, supports, brackets, valves, drains, cleanouts, hose bibs, yard hydrants, and related items.

**1.2 RELATED WORK**

- A. Related work specified in other Sections includes, but is not limited to:

- 1. Section 01 33 00                      Submittal Procedures
- 2. Section 05 45 00                      Mechanical Metal Supports
- 3. Section 09 90 00                      Painting and Finishes
- 4. Section 33 05 26                      Utility Identification
- 5. Section 33 12 00                      Mechanical Appurtenances
- 6. Section 33 13 00                      Pipeline Testing and Disinfection
- 7. Section 40 05 13.19                      Stainless Steel Process Piping

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
  - 1. B31.1              Power Piping
- C. AMERICAN STANDARDS FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 74              Standard Specification for Cast Iron Soil Pipe and Fittings
  - 2. ASTM B 43              Standards for Seamless Red Brass Pipe
- D. CAST IRON SOIL PIPE INSTITUTE (CISPI)
  - 1. CISPI 301              Standard Specification for Hub-less Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- E. INTERNATIONAL MECHANICAL CODE (IMC)
- F. INTERNATIONAL PLUMBING CODE (IPC)

## G. FACTORY MUTUAL INSURANCE COMPANY (FM GLOBAL)

1. FM 1680 Approval Standard for Couplings Used in Hubless Cast Iron Systems for Drain, Waste or Vent, Sewer, Rainwater or Storm Drain Systems Above and Below Ground, Industrial/Commercial and Residential

### 1.4 PIPING SYSTEM LAYOUTS

- A. Piping system drawings are diagrammatic and are intended to show approximate location of equipment and piping. Verify dimensions and elevations, whether in figures or scaled, in the field. CONTRACTOR is responsible for the installation of complete and workable systems whether completely detailed on the plans or not.
- B. Ascertain locations of apparatus, fixtures, equipment, and piping in the field, and layout work accordingly. ENGINEER reserves the right to make minor changes in location of piping and equipment up to the time of installation without additional cost to OWNER.

### 1.5 SUBMITTALS

- A. Provide Submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit general arrangement drawings of system components.
- C. Submit product catalog cut sheets and other manufacturer information.

### 1.6 REQUIREMENTS OF REGULATORY AGENCIES

- A. Install work per applicable provisions of codes, rules, regulations, statutes, and ordinances of authorities having jurisdiction.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. Plumbing piping and specialties shall be as recommended by the manufacturer for the intended use.
- B. Any pipe, plumbing fitting or fixture, solder, or flux used in the installation or repair of any potable water system shall be “lead free” except where necessary for the repair of leaded joints of cast iron pipes.

### 2.2 PIPING AND FITTINGS

- A. Cast iron sanitary, storm, vent pipe and fittings shall be manufactured in accordance with ASTM A 74.
- B. Hub-less cast-iron soil pipe and fittings with **Camp-All** type pipe couplings, or approved equal, shall be used for above ground sanitary, storm, and vent piping where approved for use by local authorities.
- C. Hub-less cast-iron soil pipe and fittings shall meet CISPI Standard 301.



- D. Pipe couplings shall have high-torque capacity and shall meet FM Standard 1680.

## 2.3 PIPE HANGERS AND SUPPORTS

- A. Pipe hangers and supports shall meet the requirements of IMC Section 305 Pipe Support, Section 05 45 00 – Mechanical Metal Supports, and the following. If there is a discrepancy in the requirements of these documents the more stringent requirement shall apply.
- B. Properly support, suspend, or anchor all piping and fittings to prevent sagging, over stressing, or longitudinal movement of piping, and to prevent thrust or loads on or against other equipment.
- C. Support horizontal piping on adjustable split steel ring or clevis hangers. The following schedule shows minimum spacing.
  - 1. Steel, Brass and Copper:
    - a. 1-1/4" and smaller 6'-0" on center
    - b. 1-1/2" thru 3" 8'-0" on center
    - c. 4" and larger 12'-0" on center
  - 2. PVC, CPVC, AND ABS:
    - a. 1" and smaller 4'-0" on center
    - b. 1-1/4" thru 2" 5'-0" on center
    - c. 2-1/2" thru 4" 6'-0" on center
    - d. 5" and larger 8'-0" on center
- D. Support insulated piping with pipe saddles and hangers that fit on outside of insulation. Do not compress or damage pipe insulation with hangers or supports.
- E. Provide all rigid hangers with a means of vertical adjustment after erection.
- F. Use copper or copper plated hangers for supporting uninsulated copper pipe.
- G. All vertical and horizontal piping supports shall be fiberglass **EnduroStrut by Enduro Systems, Inc.**, or approved equal.
- H. Perforated strap hangers or wire supports will not be permitted.

## 2.4 INSERTS

- A. Furnish and set inserts in concrete forms; provide reinforcing rods for pipe sizes over 3 inches or equivalent.
- B. Furnish concrete inserts as follows: Black, malleable iron, universal type for threaded connections with lateral adjustment. Inserts shall be galvanized unless noted otherwise on the Drawings.

## 2.5 INSULATION

- A. Hot water piping, valves, fittings, and exposed horizontal sanitary, storm, and vent piping shall be provided with one-inch thick insulation.

- B. Covering valves, flanges, fittings, and ends of insulation with pre-molded high- and low-temperature PVC fitting cover, end cap, or similar pre-formed unit. The pre-formed unit covers shall be sized to receive the same thickness insulation as used in adjacent piping.
- C. Exposed supply and drain piping for lavatories shall be insulated under the wash basins in order to prevent burns and abrasions to handicapped persons. Removeable insulated covers shall be **Handy-Shield Type by Plumberex Specialty Products**, or approved equal.

## **2.6 SHIELDS**

- A. Provide shields to protect insulation in all areas.
- B. Provide approved galvanized form shields to isolate pipe in contact with hangers and supports.
- C. Furnish low compressive insulation protector shields. Size the shields per the manufacturer's recommendations.

## **2.7 SLEEVES**

- A. Where pipes pass through floors, footings, foundations, walls, or ceilings, furnish and install pipe sleeves. Sleeves for concealed piping shall be of Schedule 40 galvanized steel pipe one size larger than the pipe passing through. For exposed piping Schedule 40 black steel pipe installed so as to be completely covered by escutcheons. Extend sleeves through floors 1/2-inch above finish floor.

## **2.8 ESCUTCHEONS**

- A. Fit pipe passing through walls, floors, or ceilings with escutcheons with set screws.
- B. Use prime painted escutcheons where surface is to receive a paint finish; otherwise, use escutcheons that are nickel or chromium plated.
- C. Where piping is insulated, use escutcheon outside the insulation.

## **2.9 JOINTS**

- A. For screwed pipe make ends with sharp, clean tapered threads using Teflon tape on the male thread only. Do not use mill cut threads. Ream cut pipe to full inside diameter.
- B. Welding may be done by either the arc or acetylene process conforming to the requirements for the ASME B31.1.
- C. For solder joints use fittings specifically made for soldering. Clean all burrs and roughen pipe to clean; solder complete around joint.
- D. For grooved pipe jointing systems use mechanical pipe couplings and fittings.
- E. For no-hub cast iron soil pipe use double screw joint neoprene coupler.

## **2.10 UNIONS**

- A. Furnish and install unions for each valve or piece of equipment to permit easy installation and removal of equipment.

## **2.11 VALVES**

- A. Water shutoff valves shall be the gate or ball type as designated on the drawings, except on fixture supply piping where globe style valves shall be used.
- B. Hose Bibs shall be provided where indicated on the Contract Drawings. The hose nipple shall be a female iron pipe thread inlet with hose thread outlet. Hose bibs shall be 3/4-inch in size unless noted otherwise on the Contract Drawings.
- C. Gate and ball valves shall be in accordance with Section 33 12 00 – Mechanical Appurtenances.

## **2.12 9-INCH FLOOR DRAINS IN CONCRETE FLOORS**

- A. Floor drains in concrete floors shall be constructed of cast iron of the size indicated on the Contract Drawings and provided with sediment buckets. Provide with 1/2-inch trap primer connection.
- B. Each floor drain located on an upper floor shall have a clamping collar with 4-pound sheet lead flashing 12 inches minimum all around. Where flashing does not comply with local code use epoxy waterproofing membrane.
- C. Floor drains shall be **Z520-Y by Zurn Industries, 32100-AE-81 by Josam Company, Figure 2350 by Jay R Smith Mfg. Co.**, or approved equal.

## **2.13 5-INCH FLOOR DRAINS IN CONCRETE FLOORS**

- A. 5-inch floor drains in concrete floors shall be constructed of cast iron with polished nickel bronze top of the size indicated on the Contract Drawings. Provide with 1/2-inch trap primer connection.
- B. Floor drains shall be **ZN415B-P by Zurn Industries, Series 3100 by Josam Company, Figure 2051 by Jay R Smith Mfg. Co.**, or approved equal.

## **2.14 FLOOR CLEANOUTS**

- A. Cleanouts in concrete floors shall be heavy plugs with tapered shoulders against heavy brass plugs.
- B. Cleanout shall have a minimum diameter of 3-inches.
- C. Floor cleanouts shall be fabricated from cast iron with gas and watertight ABS tapered thread plug.
- D. Floor cleanout shall be **Z1400 by Zurn Industries, 55000 Series by Josam Company, 4237 Series by Jay R Smith Mfg. Co.**, or approved equal.

## 2.15 WALL CLEANOUT

- A. Provide a wall cleanout Tee with coated cast iron body, gas and watertight bronze tapered thread plug, and round, smooth stainless steel wall access cover with securing screw.
- B. Wall cleanout shall be **Z1446 by Zurn Industries, 58910 Series by Josam Company, Jay R Smith Mfg. Co.**, or approved equal.

## 2.16 CHANNEL DRAINS IN CONCRETE FLOORS

- A. Channel drain system shall be 4-inch nominal clear opening precast units with a 0.5-inch minimum wall thickness. Units shall be manufactured with an invert slope of 0.5%. Trench system bodies shall be manufactured from polyester polymer concrete with minimum 14,000 psi compressive strength and 4,000 psi flexural strength. Each unit shall have a partial radius trench bottom with male to female interconnecting end profile. Units shall have anchoring keys on the outside wall. A minimum 3/32-inch-thick stainless steel edge rail shall be integrally cast in the polymer concrete body. The channel drain system shall be **KS200 by ACO, Inc.** or approved equal.
- B. Grating (Pedestrian Traffic) – Manufactured from minimum 16-gauge Type 304 stainless steel. Slotted grates shall have a minimum intake area of 17.6 square inch per half meter of grate. Grates shall be Load Class A certified for a minimum of 3,500 lbs – 70 psi. The model and Manufacturer shall be **Type 450Q/452Q slotted stainless steel grate by ACO Polymer Products, Inc.**, or approved equal.

## 2.17 HOSE BIBBS

- A. Hose bibbs shall be supplied with separate tamper proof vacuum breaker to be attached to the hose bibb after hose bibb installation. Hose bibbs shall be 3/4-inch cast brass with cast iron handwheel and adjustable packing nut. Hose bibbs manufacturer shall be **Watts SC8 Series, American Valve M74, Jay R Smith 5670-H**, or approved equal.

## 2.18 AIR GAP DRAINS

- A. Air gaps shall be installed to provide a physical separation between the discharge of a water supply pipe or air valve vent pipe and the drain piping. The air gaps shall be bronze, or epoxy coated cast iron and shall be ANSI/ASME A112.1.2 approved. An air gap fitting shall be provided unless otherwise indicated in the Contract Drawings. Air gaps shall be Zurn Model AG, Watts 909AG, or approved equal.

## 2.19 FLOOR MOUNTED VANITY WITH COUNTERTOP (LAV-1)

- A. Codes: ASME A112.19.2; ICC/ANSI A117.1
- B. Vanity Material: Solid birch and rubber wood solid frame with EO plywood panels or medium density fiberboard (MDF). Provide with double doors and optional bottom drawer. Color shall be grey with chrome hardware.
- C. Size: Nominal 30" x 22"
- D. Countertop with integral basin: Cultured Marble, white

- E. Faucet Holes: Center hole only.
- F. Drain: grid strainer without overflow, solid brass with brush nickel finish, meeting ASME A112.18.2.
- G. Manufacturer, or approved equal:
  - 1. Lexora - Jacques LVJ30SB300 (Available at Home Depot)
  - 2. Vanity Art – CVI130-G-BN (Available at Home Depot)
  - 3. Wyndham –Miranda (Available at Lowes)

## **2.20 SOLID-BRASS, MANUALLY OPERATED FAUCETS**

- A. Codes: ASME A112.18.1. Comply with NSF 372 for faucet materials that will be in contact with potable water.
- B. Polish chrome plated cast brass single lavatory faucet with an integral 5-inch cast spout, a ceramic disc cartridge and a temperature limit stop. Furnish with a 2.2 GPM pressure compensating aerator, a metal ADA compliant lever handle, stainless steel flex connection hoses, and mounting hardware.
- C. Manufacturer, or approved equal:
  - 1. American Standard – Model 6114.111
  - 2. Kohler Company – Model K-10215-4
  - 3. Zurn Industries – Model Z82200-XL

## **2.21 FLOOR MOUNTED FLUSHOMETER ADA COMPLIANT TOILET SYSTEM (WC-1)**

- A. Codes: ASME A112.19; ICC/ANSI A117.1
- B. Bowl
  - 1. Floor mount elongated flushometer valve toilet
  - 2. Vitreous china, white
  - 3. High Efficiency, Operates with 1.1 to 1.6 gpf
  - 4. Conventional glaze
  - 5. 10" or 12" roughing-in
  - 6. Nominal 16" rim height for accessible application
  - 7. Condensation channel
  - 8. Powerful direct-fed siphon jet action
  - 9. Fully glazed 2-1/8" trap way
  - 10. 10" x 12" of 10"x7" water surface area
  - 11. 1-1/2" inlet spud
- C. Manual Flush Valve
  - 1. Self-cleaning brass piston with integral wiper spring
  - 2. Piston operation delivers superior flush accuracy and repeatability
  - 3. Piston valve remains closed and does not need to be reset after loss of water pressure
  - 4. ADA compliant non-hold open handle
  - 5. Positive seal ensures leak-free performance

6. No external volume adjustment
7. Durable chrome-plated cast brass construction
8. Chloramine-resistant rubber seals
9. Adjustable tailpiece for rough-in flexibility
10. Can be installed left or right hand

D. Manufacturer, or approved equal:

1. American Standard – Model 2857.016 (Bowl 3043.001, Valve 6047.16)
2. Kohler Company – Model Bowl K-96057-B, Valve L76322
3. Zurn Industries – Model Bowl Z.WC4.AM, Valve Z6000AV-HET

## **2.22 TOILET SEAT:**

- A. Standard: IAPMO/ANSI Z124.5.
- B. Material: Plastic.
- C. Type: Commercial (Heavy duty).
- D. Shape: Elongated rim, open front.
- E. Hinge: Self-sustaining.
- F. Hinge Material: Non-corroding metal.
- G. Seat Cover: Not required.
- H. Color: White.
- I. Manufacturer, or approved equal:

1. American Standard – Model 5901.100SS
2. Kohler Company – Model K4731-CA
3. Zurn Industries – Model Z5955SS-EL

## **2.23 PLUMBING SUPPLY FITTINGS**

- A. NSF Standard: Comply with NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Codes: ASME A112.18.1
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type, or compression valve with inlet connection matching supply piping.
- E. Operation: Wheel handle.
- F. Risers:

1. NPS 3/8.
2. ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. Prior to installation of piping, verify that it will not interfere with clearances required for the erection and finish of structural members, architectural members, electrical, sprinkler, or mechanical items.
- B. Hang or support piping materials from roof support system whenever possible.
- C. Do not cut any structural members for installation of piping.

### **3.2 INSERTS**

- A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.
- B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 3 inches in diameter.
- C. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
- D. Where inserts are omitted, drill through concrete slab from below and provide rod with recessed squared steel plate and nut above slab.

### **3.3 SLEEVES**

- A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.
- B. Extend sleeves through potentially wet floors 1 inch above finished floor level. Caulk sleeves full depth and provide floor plate.
- C. Where piping passes through floor, ceiling, or wall, close-off space between pipe and construction with noncombustible insulation. Provide tight-fitting metal caps on both sides and caulk.

### **3.4 PIPE HANGERS AND SUPPORTS**

- A. Support all piping and make adequate provisions for expansion, contraction, slope and anchorage.
- B. The use of pipe hooks, chains, or perforated metal for pipe support will not be permitted.
- C. Suspend all piping in the building as indicated.
- D. Install hangers to provide minimum 1/2-inch clear space between finished covering and adjacent work.
- E. Place a hanger within 1 foot of each horizontal elbow.

- F. Use hangers which are vertically adjustable 1-1/2 inch minimum after piping is erected.
- G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- H. Where practical, support riser piping independently of connected horizontal piping.

### **3.5 PIPING INSTALLATION**

- A. Cut piping accurately for fabrication to measurements established at the construction site and work into place without springing or forcing.
- B. Remove burrs and cutting slag from pipe by reaming or other approved cleaning methods.
- C. Make changes in direction with proper fittings.
- D. Arrange piping so as not to interfere with the removal of other equipment, ducts, or devices. Do not block doors, windows, or access openings. Provide unions in the piping at connections to all equipment. Unions must be accessible.
- E. Cap or plug open ends of pipes and equipment with PVC caps or expanding neoprene plugs to keep dirt and other foreign materials out of the system. Plugs of rags, wool, cotton, waste, or similar materials are not acceptable.
- F. Install all piping systems so they can easily be drained. Provide anti-siphon hose bibbs at low points on water lines.
- G. Slope all soil and waste lines within the building at 1/4 inch per foot fall in the direction of flow unless indicated otherwise.

### **3.6 PRIMING AND COATING**

- A. Prime coat exposed steel hangers and supports and hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces in accordance with Section 09 90 00 – Painting and Finishes.

### **3.7 PIPE LABELING**

- A. Exposed pipe shall be labeled in accordance with Utah State Regulation R309-525-8, Section 33 05 26 – Utility Identification, and the IPC.
  - 1. Labeling shall include direction arrows for flow.

### **3.8 DISINFECTION AND TESTING**

- A. CONTRACTOR shall perform such tests as are required by local ordinances and codes in the presence of the local governing authority inspector to show that piping is tight, leak free, and otherwise satisfactory, and shall perform such tests as ENGINEER may direct to ensure that fixtures and equipment operate properly.
- B. Disinfect potable water piping in accordance with Section 33 13 00 - Pipeline Testing and Disinfection.



- C. Test all potable water piping.
- D. Repair defects which develop under tests promptly and repeat tests. No caulking or screwed joints, cracks, or holes will be permitted. Replace pipe or fitting or both with new material when repairing leaks in screwed joints.
- E. Repair leaks in copper tubing by melting out joint, thoroughly cleaning both tubing and fitting, and resoldering.

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**SECTION 23 05 00**  
**GENERAL HVAC REQUIREMENTS**

**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 work of this section.

Sections of other Divisions which relate to HVAC work apply to the work of this section. See various Sections on sitework, underfloor work, structural work, finish materials, etc.

Related Sections: Refer to Section 23 06 07 "Motors, Drives & Electrical Requirements" for basic electrical requirements for all HVAC equipment. Special and specific electrical requirements are specified within each respective equipment specification section.

Section 26 05 00 – "Electrical General Requirements" applies to the HVAC work.

- 1.2 SUMMARY:** This Section specifies the basic requirements for HVAC installations and includes requirements common to more than one of the Division 23 HVAC sections. It expands and supplements the requirements of Division 1 and the Mechanical Sections 21, 22 and 33.

This Division does not define, nor is it limited by, trade jurisdictions. All work described herein is a part of the General Contract and is required of the Contractor regardless.

- 1.3 DESCRIPTION OF PROJECT:** The HVAC work described in these Division 23 specifications is for North Bench Pump Station project located in Salt Lake City, Utah. Design weather conditions are: 95°F db, 63°F wb and winter 0°F. Altitude readings, unless otherwise noted, are for an elevation of approximately 4,800feet above sea level. Make adjustment to manufacturer's performance data as needed.

Work includes:

- A. HVAC systems for the New Pump House and Electrical Room.

**1.4 CODES AND PERMITS, AUTHORITIES HAVING JURISDICTION:**

- A. Perform the HVAC work in strict accordance with the applicable provisions of the various codes. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications govern.
- B. Hold and save the Owner and Engineer free and harmless from liability of any nature or kind arising from Contractor failure to comply with codes and ordinances.
- C. Secure permits necessary for the prosecution of the work under this contract. Contractor to pay all fees.

D. Referenced Standards:

American Welding Society  
International Mechanical Code/State Code  
International Building Code/State Code  
International Plumbing Code with amendments  
International Fuel Gas Code 2006  
SMACNA Duct Design Standards  
Locally enforced NFPA Codes  
    NFPA 90A related to general Heating and Ventilation  
    NFPA 820 related to Ventilation of Water Treatment Plants  
Local Fuel Utility Regulations  
Local Power Utility Regulations  
American Gas Association Standards  
ASME Codes for Pressure Vessels and Piping  
ANSI B31.1 Piping

- E. Review of work in progress will be made throughout the course of the work. Final review by the Engineer will not be made nor Certificate of Substantial Completion issued until certificates of acceptability from the Authorities having jurisdiction are delivered.

**1.5 DEFINITION OF PLANS AND SPECIFICATIONS:** The HVAC drawings at reduced scale show the general arrangement of piping, ductwork, equipment, etc., and, after prior coordination, are to be followed as closely as the actual building construction and the work of other trades will permit. The architectural and structural drawings shall be considered as part of the work insofar as these drawings furnish the Contractor with information relating to design and construction of the building. Structural, Architectural, Mechanical and Electrical drawings take precedence over HVAC drawings. Request clarification and participate in resolution in the event of conflict.

Because of the small scale of the HVAC drawings, it is neither possible nor intended to indicate all offsets, fittings and accessories which may be required. Investigate the structural and finish conditions affecting the work and arrange the work accordingly, providing such extensions, offsets, adaptations, fittings, valves and accessories to meet the conditions as may be required. Some small scale work is not shown such as control conduit and piping, incidental piping, and specialties. Only those who are experienced in this type of construction are invited to the work. Provide in complete detail as directed by note, specification, and common "good practice or standard."

Examine the actual construction site prior to bidding and obtain an understanding of the existing conditions under which the work will be performed. No allowances will be made for failure to make such examination.

During construction, set up the rough work, and verify the evolving dimensions governing the HVAC work at the building. Do not claim or expect extra compensation because of differences between actual dimensions and those indicated on the drawings. Examine adjoining work on which HVAC work is dependent for perfect efficiency, and report any work of other trades which must be corrected. No waiver of responsibility for defective

work shall be claimed or allowed due to unfavorable construction consequent conditions affecting the HVAC work.

#### **1.6 ROUGH-IN:**

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Refer to equipment specifications in Divisions 3 through 44 for rough-in requirements.

#### **1.7 HVAC INSTALLATIONS:**

A. Equipment Arrangement: Unless specifically indicated otherwise, the arrangement of equipment indicated is based upon information available at the time of design and is not intended to show exact dimensions particular to a specific manufacturer. Some aspects of the drawings are diagrammatic and some features of the illustrated equipment arrangement may require revision to meet the actual equipment requirements. Structural supports, foundations, piping and valve connections, and electrical and instrumentation connections indicated may have to be altered to accommodate the equipment provided. No additional payment will be made for such revisions and alterations. Substantiating calculations and drawings shall be submitted prior to beginning the installation of equipment.

B. Coordinate HVAC equipment and materials installation with other building components.

C. Verify all dimensions by field measurements.

D. Arrange for chases, slots, and openings in other building components to allow for HVAC installations.

E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.

F. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.

G. Coordinate the cutting and patching of building components to accommodate installation of HVAC equipment and materials.

H. Where mounting heights are not detailed or dimensioned, install HVAC services and overhead equipment to provide the maximum headroom possible.

I. Install HVAC equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.

J. Coordinate the installation of HVAC materials and equipment above ceilings with suspension system, light fixtures, and other installations.

K. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

L. Where HVAC work penetrates other trade work such as poured in place concrete, gypsum board or masonry walls, etc., penetration shall be neatly cut and sleeved, and the rough wall opening shall be filled and patched.

## **1.8 EQUIPMENT SUPPORTS AND FOUNDATIONS**

A. Equipment Supports: Unless otherwise indicated, equipment supports, anchors, and restrainers shall be adequately designed for static, dynamic, wind, and seismic loads as stated in the 2015 (or latest edition) International Building Code (IBC), Chapter 16 and ASCE 7-05. Submitted design calculations for equipment supports and anchorage shall bear the signature and seal of a Registered Professional Engineer licensed in the State of Utah, unless otherwise indicated. Calculations shall account for forces and distribution of forces on supporting structures resulting from normal operation, normal operation plus seismic loadings, normal operation plus wind loadings, as well as the other load combinations stated the 2006 IBC.

B. Wall-mounted equipment weighing more than 250 pounds or which is within 18-inches above the floor shall be provided with fabricated steel supports. Pedestals shall be of welded steel. If the supported equipment is a panel or cabinet or is enclosed with removable sides, the pedestal shall match the supported equipment in appearance and dimensions.

C. Wind Load: The wind load shall be calculated in accordance with ASCE 7-05, Chapter 6, using the following design parameters:

1. Wind Speed: 90 mph
2. Exposure: C
3. Importance Factor:  $I_w = 1.15$

D. Seismic Loads: The seismic lateral and vertical forces shall be calculated in accordance with the ASCE 7-05, Chapters 11 and 13, using the appropriate design parameters for the respective site location. Provide values for the following categories as part of the Seismic Submittal.

1. Site Class
2. Seismic Design Category (SDC)
3. Seismic Importance Factor:
  - a. Short Period Spectral Acceleration
  - b. Second Period Spectral Acceleration

E. Hydrodynamic Forces: Hydrodynamic forces calculated in accordance with AWWA D100, API 650 or ACI 350.3-06 shall be based on the appropriate parameters for the respective site location. Provide values for the following categories as part of the Seismic Submittal.

1. Site Class

2. Seismic Design Category (SDC)

3. Seismic Importance Factor:
  - a. Short Period Spectral Acceleration
  - b. Second Period Spectral Acceleration

F. Anchors: Anchor bolts shall be in accordance with Section 05500 - Miscellaneous Metalwork, and shall be designed to resist the above loads. Anchor bolt calculations shall clearly show that the capacity of the anchor and the capacity of the concrete that the anchor is embedded in are adequate to resist all loads stated in the 2015 (or latest edition) IBC and ASCE 7-05, including lateral wind and lateral and vertical seismic loads. Reduction factors associated with edge distance embed length, and bolt spacing shall all be considered and based on the actual dimensions of the concrete that resists the anchorage forces. Anchor bolt details shall include required bolt diameter, embed, and edge distances. Further, the design of Anchors shall consider the ductility requirements stated in ASCE 7-05, Chapter 13, Section 13.4.2 and Chapter 15, Section 15.7.3. Anchor bolt calculations and details shall be submitted and shall bear the signature and seal of a Registered Professional Engineer licensed in the State of Utah.

G. Equipment Foundations: Mechanical equipment, tanks, control cabinets, enclosures, and related equipment shall be mounted on minimum 4-inch high concrete bases, unless otherwise indicated. Equipment foundations are indicated on Drawings. The CONTRACTOR, through the equipment manufacturer, shall verify the size and weight of equipment foundation to insure compatibility with equipment. The dimensions of all concrete bases shall be sufficient to provide the edge distances required by the anchor bolt calculations.

## **1.9 ACCESSIBILITY**

- A. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing.
- B. Extend all grease fittings to an accessible location.
- C. Establish required clearance to all installation features involving operation and maintenance. Respect manufacturer's recommendations for access and clearance.
- D. Access Doors - General: All items of HVAC equipment which may require maintenance, replacement or which control a system function shall be made readily accessible to personnel operating the building.
  1. Provide access doors in all ductwork or plenums as required to maintain filters, dampers, equipment, controls or other elements of the system. Doors shall be double wall, framed, hinged and provided with latches and shall conform to SMACNA standards, unless otherwise detailed or specified.

**1.10 CHANGE ORDERS:** See General Conditions.

**1.11 ALTERNATIVE CONSTRUCTION/SUBSTITUTION:** These documents outline a way in which the Owner may be delivered a functional and reliable facility. Drawings and



specifications describe reasonable engineering practice for the Contractor to follow.

Coordination between trades may result in periodic needs to adjust the installation from that indicated, but in no case shall the intended function be compromised.

The Contractor may perceive some material or work methods which differ from those specified which could save time and effort without compromising quality. These may be presented to the Engineer with a breakdown of possible cost savings for review. Implement changes only with authorization.

Materials substitutions will generally be covered in a review process prior to bidding. After bidding, material or equipment substitutions shall be proposed only on the basis of definitive cost accounting and implemented only with authorization.

## **1.12 CUTTING AND PATCHING**

- A. Lay out the project where new work is involved ahead of time, providing sleeves and block outs, and have work specifically formed, poured and framed to accommodate HVAC installations. Cut and patch only as needed. Repair wall or floor where cutting and patching is needed to match existing.
- B. Refer to Division 26 Section: ELECTRICAL GENERAL REQUIREMENTS for requirements for cutting and patching for electrical equipment, components, and materials.
- C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.
- D. Arrange for repairs required to restore other and any work damaged as a result of HVAC installations.
- E. No additional compensation will be authorized for cutting and patching Work that is necessitated by ill-timed, defective, or non-conforming installations.
- F. Perform cutting, fitting, and patching of HVAC equipment and materials required to:
  - 1. Uncover Work to provide for installation of ill-timed Work;
  - 2. Remove and replace defective Work;
  - 3. Remove and replace Work not conforming to requirements of the Contract Documents;
  - 4. Remove samples of installed Work as specified for testing;
  - 5. Install equipment and materials in existing structures.
- G. Upon written instructions from the Engineer, uncover and restore Work to provide for Engineer observation of concealed Work.
- H. Cut, remove and legally dispose of selected HVAC equipment, components, and materials as indicated, including, but not limited to removal of HVAC piping and other HVAC items

made obsolete by the new Work.

- I. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
- J. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

**1.13 SUBMITTALS:** Submittal of shop drawings, product data, and samples will be accepted only from the Contractor to the Engineer. Submittal shall meet the requirements of section 01 30 00 – Submittals. Data submitted from subcontractors and material suppliers directly to the Engineer will not be processed. There is opportunity and allowance for discussion prior to submittal. Document each transmittal at each transfer level of the process, and sign and stamp the submittal indicating that it has been reviewed and is in compliance with the criteria of the project, any exceptions being clearly noted. Submittals are to include all supporting calculations for the equipment, supports and anchorage of the equipment.

- A. **SHOP DRAWINGS:** As soon as possible after the contract is awarded, submit to the Engineer, an electronic copy of the descriptive literature covering all equipment and materials to be used in the installation of HVAC systems for this project. Obtain written confirmation of acceptable review by the Owner's Representative before ordering, purchasing, acquiring or installing any such equipment or materials for the project.

Prepare the submittals in an orderly manner after the order of this specification, with identification tabs for each item or group of related items. Clearly indicate performance, quality, utility requirements, dimensions of size, connection points and other information pertinent to effective review.

Equipment must fit into the available space with allowance for operation, maintenance, etc. The Contractor shall take full responsibility for space and utility requirements for equipment installed. Do not submit anything that will not fit or will not work.

Factory-wired equipment shall include shop drawings of all internal wiring to be furnished with unit.

Review by the Engineer will be for general conformance of the submitted equipment of the project specification; in no way does such approval relieve Contractor of his obligation to furnish equipment and materials that comply in detail to the specification, nor does it relieve the Contractor of his obligation to lay out ahead of time to determine actual field dimensions and conditions which may affect his work.

- B. **Record Drawings:** See Division 1. During the course of construction, maintain a set of drawings, specifications, change orders, shop drawings, addenda, etc., for reference and upon which all deviations from the original layout are recorded. Turn these marked up documents over to the Engineer within 90 days of system acceptance so that the original tracings can be revised. If the Contractor fails to mark up the prints, he shall reimburse the Engineer for the time required to do so.

#### **1.14 OPERATION AND MAINTENANCE TRAINING**

- A. Instruction of Owner's Personnel: At a time prior to Owner making use of a device or system, and in general after testing and balance work for a building or major system is complete, prepare, schedule and conduct a series of training sessions for Owner's operating and supervisory personnel. Instructions shall cover each device and system with emphasis on understanding of the purpose and function, the maintenance requirements and the proper adjustment and operating technique.
- B. Instruct building operating staff in operation and maintenance of HVAC systems utilizing Operation and Maintenance Manual when so doing.
- C. Contractor to video tape instruction sessions, and give video tape to owner.
- D. Minimum instruction periods shall be as follows:
  - 1. HVAC - 8 hours, or more as needed.
  - 2. Temperature Control - 8 hours, or more. Programming help as needed. Coordinate with Divisions 26 and 40 for Instrumentation and HVAC control.
- E. Initial instruction periods shall occur after pre-final inspection when systems are properly working and before final payment is made. Schedule subsequent visits with the Building Operation Personnel throughout the first year.
- F. Vendors for each piece of equipment, controls, etc., shall participate along with the Contractor(s).

#### **1.15 GUARANTEE/WARRANTY:** The following guarantee is a part of this specification and is binding on the part of the Contractor and his assigns:

"Contractor guarantees that this installation is in accordance with the terms of the Contract and is free from HVAC defects. He agrees to replace or repair, to the satisfaction of the Owner's Representative, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after final acceptance. See also the General Conditions of these specifications. Failed equipment in the repair or replacement shall be guaranteed for one full year from the date of "Substantial Completion."

Compile and assemble the warranties required by Division 23 into a separated set of vinyl covered, insert sheets, tabulated and indexed for each reference, included in the O & M Manual.

Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, and telephone numbers and procedures for filing a claim and obtaining warranty services.

HVAC systems and equipment shall not be considered for substantial completion and initiation of warranty until they have performed in service continuously without malfunction

for at least thirty (30) working days.

**1.16 TESTS AND CERTIFICATIONS:** Make all tests required by code or specification in the presence of a representative of the Owner, with tests recorded and certified by the Contractor and Representative. Involve local authorities where required.

**1.17 PERMITS, FEES, LICENSES:** Refer to General Conditions.

**1.18 CEILING SPACE AND OPEN SPACE COORDINATION:** Carefully coordinate ceiling cavity and open space with all trades; however, installation of HVAC equipment within the ceiling cavity space allocation, in the event of conflict, shall be in the following order: process piping, cable tray plumbing waste lines; supply, return and exhaust ductwork; domestic hot and cold water; fire protection; control conduit. Respect clearances required for lights, electrical conduits, protected structure, etc. All spaces above any and all ceilings shall be defined and considered as return air plenum space.

#### **1.19 HVAC RELATED CONTROLS AND INSTRUMENTATION**

- A. The Instrumentation and Controls for HVAC systems installed by this project are to be provided under Divisions 26 - Electrical and Division 40 – Process Interconnections but to be fully supported and complemented in a conventional way by providers of Sections 23 work. Extent of control systems work required by this section is indicated on drawings and schedules, and by requirements of this section.
  - 1. See following sections for Control Systems and instrumentation requirements:
    - a. Section 26 05 00 – Electrical General Requirements
    - b. Section 40 10 00 – Process Control and Instrumentation System – General
    - c. Section 23 09 00 – HVAC Control Systems
  - 2. Control sequences will be provided for Owner's programming. See Division 40.
- B. Provide for installation of instrument wells, valve bodies, and dampers in mechanical HVAC systems.
- C. Include Divisions 26 – Electrical and 40 – Instrumentation sections in the following work.
  - 1. Power supply wiring from power source to power connection on controls and/or unit control panels. Includes starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.
  - 2. Interlock wiring between electrically operated equipment units; and between equipment and field installed control devices. Interlock wiring specified as factory installed is work of this section.

3. Control wiring between field installed equipment, controls, indicating devices, and unit control panels.
  4. 24 volt and 120 volt service work required by instrumentation/control systems.
- D. Participate in "System Commissioning, Testing and Balancing".

## **PART 2 – PRODUCTS**

### **2.1 QUALITY AND CHARACTER OF MATERIALS AND EQUIPMENT:**

- A. New and conventional: All equipment and materials shall be new, and shall be the standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment, and shall be the manufacturer's latest design. Specific equipment shown in schedules on drawings and specified herein is to be the basis for the Contractor's bid. Provisions for substitute equipment are outlined in the General Conditions.
- B. Complete: Furnish and install all major items of equipment herein specified and/or called out in the equipment schedules on the drawings complete with all accessories normally supplied with catalog items listed, and with all other accessories necessary for a complete and satisfactory installation.
- C. Code Compliant: There are certain Code defined hazards associated with the Waste Water Treatment Plant environment, generally outlined in NFPA Standard 820. The Contractor in all of its entities should be familiar with the standard and provide installations which will be compliant in all regards. Of particular interest are the requirements where vagrant flammable process gases such as methane and hydrogen sulfide may develop. Such areas include the Wet Wells, Grinder Rooms and other similarly classified spaces where exhaust fans are involved to dilute the concentration of gases. All HVAC equipment involved in these areas must have an "explosion-proof" characteristic. Impose this requirement on all materials, motors, etc. provided by these Division 23 specifications.

### **2.2 PROTECTION OF MATERIALS AND EQUIPMENT:**

- A. Close pipe and duct openings with caps or plugs to prevent lodgement of dirt or trash during the course of installation. Cover equipment tightly and protect against dirt, water and chemical or HVAC injury. Plumbing fixtures intended for the final installation shall not be used by the construction forces. At the completion of the work, clean fixtures, equipment and materials and polish thoroughly and deliver in a factory dock condition for the Owner's acceptance. Make damage and defects developing before acceptance of the work good at Contractor's expense.
- B. Do not make temporary use of project equipment, during construction. **DO NOT USE PERMANENT HVAC SYSTEMS FOR TEMPORARY HEAT!!**

## **2.3 QUALIFICATIONS OF WORKMEN:**

- A. All mechanics shall be capable journeymen, skilled in the work assigned to them. Apprentices may be used with appropriate direction.
- B. Do not employ unskilled persons in the work; execute all work in a skillful and workmanlike manner. All persons employed shall be competent, faithful, orderly and satisfactory to the Owner. Should the Owner's Representative deem anyone employed on the work incompetent or unfit for his duties, and so certify, Contractor shall remove that employee from this project and he shall not be again employed upon the project without permission of the Owner's Representative.
- C. All welders involved in welding of pressure piping systems shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Written verification of successful test completion shall be submitted to Architect prior to initiating work.

**2.4 FOREMAN:** Designate an experienced and qualified general HVAC foreman for the project work to be consistently available on site during the life of the project for consultation. Do not replace this individual without prior approval from the Owner's Representative.

**2.5 USE OF COMMON VENDORS:** Regardless of subcontract delegations, coordinate purchasing between trades so that equipment and materials of similar nature come from a single vendor, i.e., all package HVAC units shall be common source. Valves, variable volume boxes, etc., the same. Do not burden the Owner with multiple brands of similar equipment unless so directed.

## **2.6 ROOF/WALL/FLOOR PENETRATIONS - FLASHINGS:**

- A. Install sleeves through the floor into dry rooms flush with the floor, caulked and sealed. Into wet rooms, extend piping above floor level to create 1" dam. Use Schedule 40 galvanized steel pipe for all pipe sleeves.
- B. Let pipe sleeves allow for movement of the pipe due to expansion and contraction, yet to include seismic restraint.
- C. Fire stopping: Provide fire stopping for all Division 23 penetrations of rated walls, floors, structure, etc. in conformance with ASTM E814 and with UL 1479.
- D. Flashings:
  - 1. Flash all equipment supports, pipes and conduit penetrating the roof. Provide required flashing components. See drawings or Architect/Engineer for additional detail.
  - 2. Clamp roof drains to roof membrane, follow manufacturer's directions.
  - 3. Make all ductwork penetrating a roof watertight with flashings, counter flashing and sealant. Provide curbs for any and all such openings.

## **2.7 EXCAVATING AND BACKFILLING (GENERAL):** Reference, if required.

- A. Provide all excavation, trenching and backfilling for HVAC underground duct and piping work. Excavation and backfilling shall comply with applicable paragraphs of Division 31. Tamp bottoms of trenches hard and, for soil and waste piping, grade to secure uniform fall of 1/4" per foot, or as noted. Excavate bell holes for hub and spigot pipes so that pipe rests on solid ground for its entire length. Lay sewer and water pipe in separate trenches, except where otherwise noted, as detailed.
- B. After work has been tested, inspected and approved by the Owner's Representative and/or State/Local Inspector, and prior to backfilling, clean the excavation of all rubbish, and clean backfill materials free of trash. Place backfill in horizontal layers not exceeding 12" in thickness, properly moistened. Compact each layer with suitable equipment to a dry density of not less than 95 percent as determined by the Modified AASHO Test T-18O. See Division 31 for additional requirements.
  - 1. Provide adequate shoring to safeguard workers from cave-ins for all excavations.
  - 2. In areas where General Contractor has finish grade work to do, HVAC Contractor shall backfill and compact to 8" below finish grade. Where no finish surface work is to be done, HVAC Contractor shall backfill and compact to and match adjacent undisturbed surface with allowance for settling, etc.
  - 3. Protect from damage all existing underground utilities or utility tunnels indicated on the contract drawings (or field located for the Contractor by the Owner prior to excavation operations). Any damage to identified existing utilities or utility tunnels shall be repaired by the Contractor at no cost to the Owner.

## **2.8 HANGERS AND SUPPORTS (GENERAL):**

- A. Provide mountings, hangers and/or supports for all HVAC equipment, piping and ductwork. Primary information is contained in these specifications as noted in, but not limited to, paragraph 1.8 above and on the drawings. Correlate HVAC work with the work of other trades to obtain a consistent manner of installation.
- B. Provide hangers and supports to correlate with seismic restraint, expansion/contraction, and vibration isolation.

## **2.9 MANUFACTURER'S DIRECTIONS:** Install all equipment in strict accordance with directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the plans and specifications, report such conflicts to the Engineer.

## **2.10 LUBRICATION:** Lubricate equipment at startup. Then, provide all lubricants for the operation of all equipment until acceptance by the Owner. The Contractor is held responsible for all damage to equipment consequent to pre-acceptance operation.

## **2.11 ELECTRICAL WIRING AND CONTROL:**

- A. In general, primary motor starters, related motor starter equipment and power wiring indicated on the electrical drawings and control diagrams are to be furnished and installed under the Division 26 Specification. Items of electrical control equipment specifically

mentioned to be furnished by the HVAC/Instrumentation (Controls) Contractor either in these specifications or on the related drawings, shall be obtained and mounted by this Contractor and shall be connected under and as required by specifications, all in compliance with the National Electric Code, and Divisions 26 and 40. Many control devices and fan motors are to be furnished and terminal block wired to a unit mounted power or control panel. The project requires this single location of connection for fan and pump motors, damper actuators, valve actuators, sensors smoke detectors and the like.

- B. Refer to the control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the contractor.
- C. HVAC electrical work must be fully coordinated with Division 26 to insure that all required components of the work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of coordination.
- D. Where the detailed electrical work is not shown on the electrical drawings, the HVAC Contractor shall furnish, install and wire or have prewired all specified and necessary controls for package air equipment specified for this project. The objective of this paragraph is to make sure a complete operating system is obtained at no additional cost to the Owner for field wiring required related to the equipment.

**2.12 FLUSHING AND DRAINING OF SYSTEMS/CLEANING OF PIPING AND DUCTS:** Blow out all refrigerant piping systems with compressed air or nitrogen to remove foreign materials that may have been left or deposited in the piping system during its erection. Duct systems shall have all debris removed and fans shall be run to blow out all dust and foreign matter before outlets are installed and connected.

Damp wipe all ductwork on installation, cap open ducts, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

**2.13 JOBSITE CLEANUP:**

- A. Keep site clean during progress of work.
- B. At the conclusion of work, clean all installation thoroughly.

Leave equipment in a factory dock condition. Correct any damage and touch up or repaint if necessary.

Remove all debris from site.

**END OF SECTION**



**SECTION 23 05 20**  
**HVAC IDENTIFICATION**

**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 work of this section.
- B. Division-23 Basic HVAC Materials and Methods section apply to work of this section.

**1.2 SUMMARY:**

- A. Label all heating, air conditioning, automatic temperature control equipment (excluding thermostats), and distribution systems. Also label all electrical switches and starters for all HVAC equipment.

**PART 2 – GENERAL MECHANICAL MATERIAL AND METHODS**

**2.1 EQUIPMENT, PIPE AND DUCT IDENTIFICATION:**

- A. Equipment Identification:
  - 1. Identify all equipment including, but not limited to, all mechanical equipment, ATC panels, controller, etc., and all other devices with signs made of laminated plastic with 1/8" or larger engraved letters.
  - 2. Give each piece of equipment its own unique equipment number or symbol.
  - 3. Information on sign shall include name of equipment, identification on plans and schedules, rating, maintenance instructions, and any other important data not included on factory attached name plate.
  - 4. Signs shall be attached to equipment so they can be easily read. Attachment shall be by rust proof screws or rivets. Do not use adhesive.
  - 5. Identification signs for equipment shall be similar to the following:
    - a. Supply Fan (F-2)  
Rating: 49,850 cfm @ 3.5" s.p. (At 1600 ft. elevation)  
Maintenance: Check bearings for lubrication every 30 days and lubricate as required with S.A.E. 30 oil.
    - b. "ATC Panel A"

**2.2 PANEL IDENTIFICATION:**

- A. Provide all panel devices on panel faces with engraved black face Formica with white engraved lettering labels.
- B. Provide all internal panel components with engraved black face Formica labels with white engraved lettering. Fasten label beneath each device.
- C. Numerically or alphabetically code all panel wiring and tubing.

**END OF SECTION**

**SECTION 23 05 30**  
**HVAC OPERATION & MAINTENANCE MANUALS**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. Division-23, Section 23 05 00 General HVAC Requirements sections apply to work of this section.

**1.2 SUMMARY:**

- A. Furnish four sets of bound operation and maintenance (O&M) manuals within 90 days of system acceptance. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to operate, maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.

**1.3 OPERATION AND MAINTENANCE MANUAL FOR MECHANICAL HVAC SYSTEMS:**

- A. General:
  - 1. The "Operating and Maintenance Manual" is a bound compilation of drawings and data that the owner requires for each building or project. Furnish these manuals, complete with drawings and data, to the Owner through the Engineer.
  - 2. The mechanical contractor has overall responsibility to obtain the necessary data from and compile the data as set forth in this specification.
  - 3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.2A.
  - 4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

**PART 2 – MATERIALS AND METHODS**

- 2.1 PAGE SIZE:** All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 17 x 11 inches) folded to 8-1/2 x 11 inch.

**2.2 DRAWINGS:** All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

**2.3 BINDERS:** Binders shall be piano hinge, bar-lock type, Buckram (stiffened fabric cover) binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, on not filling them beyond 4".

A. Place the following information on the front cover and backbone:

1. "Operation and Maintenance Manual".
2. Project Name (and volume number if more than one volume).  
Project Number (Per owner's project number).
3. Building name and number.
4. Owner's name.
5. (Architect's name.)
6. Engineer's name.
7. General Contractor's name.
8. HVAC Contractor's name.

Items 5 through 7 need not be printed on the backbone.

## **2.4 CONTENTS AND INDEXING:**

- A. Manuals shall contain descriptions of the building systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
- B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.
- C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:
  1. 11 x 17 size project drawings in "As-built" condition.
  2. Outline drawings, special construction details, "As built" electrical wiring and control diagrams for all major and supplementary systems.
  3. Manufacturer's test or calculated performance data and certified test curves.
  4. Installation, operating, and maintenance instructions, including a complete parts list and

sectional drawing with parts identification numbers. Mark with model, size and plan number.

5. Manufacturer's brochures marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included. Include performance data similar if not equivalent to the shop drawing submittal.
6. List the serial numbers of each item of equipment installed with the model numbers and plan symbols.
7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:

Part I	Building and System Descriptions
Part II	Purchased Equipment Data
Part III	Test Reports and Valve Charts
Part IV	Start-Up and Operation
Part V	Preventative Maintenance Recommendations

8. A copy of the approved submittals for each piece of equipment.
9. A copy of all testing, adjusting and balancing reports.
10. Wiring diagrams, marked with model and size and plan symbol.
11. Operating and Maintenance Manuals data for Part I shall be obtained directly from the mechanical and electrical consultants. (Allow consultant preparation cost.)
12. The index for each section shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.

### **PART 3 – EXECUTION**

(Not Used)

**END OF SECTION**

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**SECTION 23 05 93**  
**TESTING, ADJUSTING & BALANCING**

**PART 1 - GENERAL**

**1.1 GENERAL CONDITIONS:**

- A. Work of this section shall be subject to the requirements of the General Conditions of this contract, the Mechanical - General Requirements, HVAC General Requirements, General Electrical Requirements and other sections where this work shares a responsibility.
- B. System commissioning and startup of the HVAC systems shall be the responsibility of the HVAC Division 23 Contractor and his subcontractors with the participation of the Divisions 26/40 Electrical and Instrumentation Contractor(s) related to electrical and instrumentation work and the General Contractor related to general construction items.
- C. Testing and balancing shall be under the direction of the General Contractor with the full participation of all of the mechanical and electrical trades employed on the project and shall include the participation of an independent testing and balance subcontractor to coordinate all elements of the work and to perform special technical services outlined herein.

**1.2 SYSTEM COMMISSIONING - SCOPE OF WORK:**

- A. The work required under this section shall include but not necessarily be limited to the following:
  - 1. The pre-startup inspection of all HVAC systems and subsequent correction of any incorrect items.
  - 2. The initial first run inspections.
  - 3. System operations inspection.
- B. The intent of this section is to provide for proper installation, startup, service and operation of the mechanical systems in preparation for system balancing. See section for balancing of air system. After completion of the balancing, the mechanical system shall be ready for owner occupancy, with all systems operating as intended.
- C. Repair, replacement or adjustment of each item shall be performed by the respective installing subcontractor.

**1.3 TESTING AND BALANCING - SCOPE OF WORK:**

- A. This work incorporates a checkout of construction work, individual component activation and overall system activation into one work program which shall serve as the transition period from the Contractor's job to Owner's facility.
- B. The Contractor shall be skilled in the operation and manipulation of systems and in the direction of parties involved in the work.

- C. The Contractor shall participate in the startup and shakedown of all mechanical systems installed and modified in this contract; test adjust and balance these systems to obtain optimum performance at a level which minimizes the required energy input, prepare and submit a complete report of work done and the final system condition obtained, participate in the instruction of Owner's personnel in the proper operation of systems and equipment.

#### **1.4 QUALIFICATIONS OF SYSTEM COMMISSIONING AND TAB TEAM:**

- A. Representatives of Contractor shall be available on a daily basis through the commissioning and adjustment period. These men shall be experienced journeymen with prior experience in system operation and with specific experience on the construction of this project. Section 23 09 00 – HVAC Control Systems is a particular participant in the work.
- B. Balancing shall be done at the Contractor's expense by an independent firm specializing in this work. A definition of independent shall mean the firm is not associated with any engineering, contracting, or manufacturing firm and derives its income solely from testing, adjusting and balancing mechanical systems. Approved firms to do this work include:

Bob's Test and Balance – Salt Lake City, UT  
Certified Test and Balance – Salt Lake City, UT  
Barnett, Inc. (Payson Sheet Metal) – Payson, UT

- C. The balancing work shall be performed by the same firm having total professional responsibility for the final testing, adjusting and balancing of the entire system. A principal of the firm shall be directly involved in the project.
- D. The testing and balancing firm shall furnish all necessary tools, scaffolding and ladders that are required and shall provide all required instruments, take all readings and make all necessary adjustments.
- E. After all adjustments are made a detailed written report shall be prepared and submitted for approval, and shall bear the signature of the professional supervising the work. Final acceptance of this project will not be made until a satisfactory report is received. Furnish an electronic copy of the report for Engineer Review.
- F. Treat each individual system as separate elements for reporting purposes.

### **PART 2 – EXECUTION, SYSTEM COMMISSIONING**

#### **2.1 PRE-STARTUP INSPECTION:**

- A. The pre-startup inspection of all systems shall provide for verifying that each piece of equipment is properly installed and prepared for startup.
- B. All pertinent items shall be checked, including but not necessarily limited to the following:
  - 1. Removal of shipping stops.
  - 2. Vibration isolators properly aligned and adjusted.



3. Flexible connections properly aligned.
  4. Belts properly adjusted.
  5. Belt guards and safety shields in place.
  6. Safety controls, safety valves and high or low limits in operation.
  7. Filters in place and seal provided around edges.
  8. All test stations and measuring devices installed.
  9. Initial lubrication of equipment is complete.
  10. Filters are clean.
  11. Motor rotations are correct.
  12. Voltages match nameplate.
  13. Control system is in operation.
  14. All interlocks are wired and verified.
  15. All controls have been connected and verified.
  16. All dampers and operators are properly installed and operating.
  17. All ductwork is installed and connected.
  18. All other items necessary to provide for proper startup.
- C. Correct all incomplete or defective items.

## **2.2 FIRST RUN INSPECTION:**

- A. Recheck all items outlined in pre-startup inspection to insure proper operation.
- B. Check the following items:
1. Excessive vibration or noise.
  2. Loose components.
  3. Initial control settings.
  4. Motor amperages.
  5. Heat buildup in motors, bearings, etc.
  6. Control system is properly calibrated and functioning as required.
- C. Correct all items which are not operating properly.

## **2.3 SYSTEM OPERATION INSPECTION:**

- A. Observe the mechanical systems under operating conditions for sufficient time to verify proper operation under varying conditions, such as day-night and heating-cooling.
- B. Periodically check the following items:
1. Filters.
  2. Visual checks of air flow for "best guess" settings for preparation for system air balancing under section applying.
  3. Control operation, on-off sequences, system cycling, etc.
  4. Visual checks of seals, packings, operation pressures.
  5. Cleaning of excessive oil or grease.
  6. Dampers close tightly.
  7. All other items pertaining to the proper operation of the mechanical system whether specifically listed or not.

## **PART 3 – EXECUTION – TESTING AND BALANCING**

### **3.1 TOTAL MECHANICAL SYSTEM BALANCE:**

- A. The mechanical systems consist of many elements. Total system balance requires that all elements be not only individually correct, but also correct as a composite system. Therefore, participation of all parties is required in the test and balance procedure.
- B. Prior to beginning work, submit a written description of the anticipated sequence of action to the Engineer for review and comment.
- C. The testing and balance specialist shall review the contract drawings during the bid period and shall advise the Engineer of any modifications to the layout which he might suggest to facilitate the balance procedure. Modifications will be incorporated into the contract by Addendum during the bidding period.
- D. The test and balance specialist shall visit the project from time to time during the rough installation making a thorough inspection of those items which will affect his subsequent work. He shall advise the Contractor in writing with a copy to the Engineer of any work required by the contract which is not being performed adequately. This is in addition to the regular review efforts of the Engineer.

### **3.2 AIR SYSTEMS BALANCE:**

- A. Before any adjustments are made, the systems shall be checked for such items as dirty filters, duct leakage, filter leakage, damper leakage, equipment vibrations, correct damper operations, etc. All fan systems are to be adjusted to deliver design air quantities within +5%. Design static pressure is based on filters approximately 50% loaded with dirt. Pressure drop across filters during balancing shall be simulated to that condition. After balancing is completed, check motor amperage with the filters clean.
- B. Adjust exhaust air systems for air quantities shown on drawings and the proper relationship between supply and exhaust established.
- C. Exchange sheaves and/or belts as needed to adjust the RPM of all fans so they handle specified air quantity.
  - 1. Determine the sheave on supply fans so that the VFD driven fan will deliver not less than 100% cfm with fully loaded filters.
  - 2. Determine the sheave on the exhaust fans so that the VFD driven fan will fully load the motor at design cfm and 100% speed.
- D. Verify the proper operation of all air side related control functions.

### **3.3 MAJOR EQUIPMENT:**

- A. The Testing and Balancing subcontractor shall work with the Instrumentation/Controls Contractor, Owners technical staff, and Electrician in placing new fans, and other major equipment in operation. The factory representative of the equipment manufacturer shall also participate in a team effort to place this system(s) in all anticipated operating modes and make adjustments as required to obtain correct operation. The Project Engineer shall witness the final operating sequence.

### **3.4 INSTRUMENTATION/CONTROL SYSTEMS:**

- A. The Testing and Balancing Contractor shall go through the entire HVAC portion of the PLC based instrumentation and control system with the Instrumentation Contractor and Owner's technical staff, verifying proper operation of each and every device and the proper function of each system. The report shall indicate and certify such effort.

### **3.5 MISCELLANEOUS:**

- A. Observe all furnished thermal overload protection and note such in the data sheets. If thermal overload protection is incorrect, it shall be the responsibility of the trade or vendor which furnished the overload devices to furnish and install the correct size overload protection devices, and it is the responsibility of the balancing firm to verify that proper overload protection has been installed at the completion of the job.
- B. The adjusting crew shall measure and set any special conditions such as minimum air quantities; coordinate outside air, return air and relief air damper operation; check and adjust outside and return air intakes so that the system will deliver substantially the same volume on either; make tests and record data as required in "REPORT" below.
- C. When deemed necessary, take 24-hour space temperature recording and any required partial rebalance of the system shall be performed without additional cost. Successful function supercedes nominal settings in order of importance.

### **3.6 REPORT:**

- A. Provide a bound report in four copies which shall contain a general information sheet listing instruments used, method of balancing, altitude correction, and manufacturer's grille, register and diffuser data.
- B. Provide equipment data sheets listing make, size, serial number, rating, etc., of all mechanical equipment including fans, motors, starters and drives. Operating data shall include rotational speed, pressure drop across filters, coils, and other system components and measured motor current and voltage.

- C. Reports shall contain a reduced set of contract drawings with outlets marked thereon for easy identification of the nomenclature used in the data sheets.
- D. The report shall contain any abnormal or notable conditions not covered in the above.
- E. Keep and submit a copy of a daily log of all work performed with a list of work scheduled for the day and the workers on the job.

**END OF SECTION**

**SECTION 23 06 03**  
**SUPPORTING DEVICES FOR HVAC**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS:**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. This section is a Division-23 Basic HVAC Materials and Methods section, and is part of each Division-23 HVAC section making reference to supports and anchors specified herein.
- C. This section heavily references Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) manuals of standard practices.

**1.2 SUMMARY:**

- A. Extent of supports and anchors described by this section is generally indicated on drawings and/or specified in other Division-23 HVAC sections. Much support and anchorage is implied in that all HVAC installation, piping, ductwork, equipment and specialties require support and restraint. Correlate this section with Section 23 06 05 related to sound, vibration and seismic restraint.
- B. Types of supports and anchors specified in this section include the following:
  - 1. Hanger-Rod Attachments.
  - 2. Building Attachments.
  - 3. Saddles and Shields.
  - 4. Miscellaneous Materials.
  - 5. Anchors.
  - 6. Equipment Supports.
- C. Supports and anchors furnished as part of factory-fabricated equipment are specified or presumed as part of equipment assembly.
- D. Relate this section to Section 23 06 05 regarding seismic and vibration control.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of supports and anchors, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years. Typical vendors of support systems include Grinnell.

**1.4 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical product data, including installation instructions for each type of support and anchor.
- B. Shop Drawings:
  - 1. Submit manufacturer's assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of

components.

- C. Maintenance Data: Submit maintenance data and parts list for each type of support and anchor. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division-1.

## **1.5 REFERENCES:**

### **A. Codes and Standards:**

1. Code Compliance: Comply with applicable building, mechanical and plumbing codes pertaining to product materials and installation of supports and anchors.
2. UL and FM Compliance: Provide products which are UL-listed and FM approved.
3. MSS Standard Compliance:

Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

Select and apply pipe hangers and supports, complying with MSS SP-69.

Fabricate and install pipe hangers and supports, complying with MSS SP-89.

Terminology used in this section is defined in MSS SP-90.

## **PART 2 – PRODUCTS**

### **2.1 HANGER-ROD ATTACHMENTS:**

- A. General: Except as otherwise indicated, provide factory- fabricated hanger-rod attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.
- B. Steel Turnbuckles: MSS Type 13. (For adjustment up to 6" for heavy loads.)
- C. Steel Clevises: MSS Type 14. (For use on high temperature piping installations.)
- D. Swivel Turnbuckles: MSS Type 15. (For use with split pipe rings, MSS type 11.)
- E. Malleable Iron Sockets: MSS Type 16. (For attaching hanger rod to various types of building attachments.)

### **2.2 BUILDING ATTACHMENTS:**

- A. General: Except as otherwise indicated, provide factory- fabricated building attachments complying with MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods. Provide copper-plated building attachments for copper-piping systems.

- B. Concrete Inserts: MSS Type 18. (For upper attachment for suspending pipe hangers from concrete ceiling.)
- C. Top Beam C-Clamp: MSS Type 19. (Use under roof installations with bar joist construction, for attachment to top flange of structural shape.)
- D. Side Beam or Channel Clamps: MSS Type 20. (For attachment to bottom flange of beams, channels, or angles.)
- E. Center Beam Clamps: MSS Type 21. (For attachment to center of bottom flange of beams.)
- F. Welded Beam Attachments: MSS Type 22. (For attachment to bottom of beams where loads are considerable and rod sizes are large.)
- G. C-Clamps: MS Type 23. (For attachment to structural shapes.)
- H. Top Beam Clamps: MSS Type 25. (For attachment to top of beams when hanger rod is required tangent to edge of flange.)
- I. Side Beam Clamps: MSS Type 27. (For attachment to bottom of steel I-beams.)
- J. Steel Beam Clamps with Eye Nut: MSS Type 28. (Same as Type 28 with link extensions.)
- K. Linked Steel Clamps with Eye Nut: MSS Type 29. (Same as Type 28 with link extensions.)
- L. Malleable Beam Clamps: MSS Type 30. (For attachment to structural steel.)
- M. Steel Brackets: One of the following for indicated loading:
  - 1. Light Duty: MSS Type 31, to 570 pounds.
  - 2. Medium Duty: MSS Type 32, to 1,500 pounds.
  - 3. Heavy Duty: MSS Type 33, to 3,000 pounds.
- N. Side Beam Brackets: MSS Type 34. (For use on sides of steel or wooden beams.)
- O. Plate Lugs: MSS Type 57. (For attachment to steel beams where flexibility at the beam is desired.)
- P. Horizontal Travelers: MSS Type 58. (For supporting piping systems subject to linear horizontal movements where head room is limited.)

## **2.3 MANUFACTURERS OF HANGERS AND SUPPORTS:**

- A. Manufacturer: Subject to compliance with requirements, provide hangers and supports of one of the following:
  - 1. Kin-Line, Inc.
  - 2. Fee & Mason Mfg. Co.; Div. Figgie International
  - 3. ITT Grinnel Corp.
  - 4. B-Line

## 5. Unistrut

**2.4 OUTSIDE AREAS:** Use galvanized hangers, attachments, rods, nuts, bolts, and other accessories for all outside areas.

## **2.5 MISCELLANEOUS MATERIALS:**

- A. Metal Framing: Provide products complying with NEMA STD ML 1.
- B. Steel Plates, Shapes and Bars: Provide products complying with ASTM A 36.
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration. Use Embeco or Engineer approved equal grout for non-shrink applications.
- D. Heavy Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS standards.
- E. Pipe Guides: Provide factory-fabricated guides, of cast semi- steel or heavy fabricated steel, consisting of bolted two- section outer cylinder and base with two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

## **PART 3 – EXECUTION**

### **3.1 INSPECTION:**

- A. Examine areas and conditions under which supports and anchors are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### **3.2 PREPARATION:**

- A. Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.
- B. Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, inspection and testing agency representatives (if any), installers of other work requiring coordination with work of this section and Engineer for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

### **3.3 INSTALLATION OF BUILDING ATTACHMENTS:**

- A. Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete



is placed; fasten insert securely to forms.

Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through the openings at the tops of inserts.

### **3.4 INSTALLATION OF HANGERS AND SUPPORTS:**

- A. General: Install hangers, supports, clamps and attachments to rigidly support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.
- B. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
- C. Prevent electrolysis in support of copper tubing by the use of hangers and supports which are copper plated, or by isolating with foam rubber covering or 30 mil insulating tape.
- D. Provisions for Movement:

Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

Install supports within 2 feet of non-vertical flex connectors

- E. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- F. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 Pressure Piping Codes are not exceeded.
- G. Insulated Piping: Do not allow hangers to come in contact with pipe where pipe is specified to be insulated.
- H. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.
- I. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install galvanized steel protective shields. Install calcium silicate blocks (12" long minimum) at support points.
- J. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.

### **3.5 INSTALLATION OF ANCHORS:**

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer for loading and stresses to connected equipment.

- B. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
- D. Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

### **3.6 EQUIPMENT SUPPORTS:**

- A. Concrete curbs for exterior mounted HVAC equipment shall be provided by the General Contractor. Anchor to curbs provided. Provide weather tight seal.
- B. Provide structural steel supports for equipment not floor or wall mounted. Construct of structural steel members or steel pipe and fittings.

### **3.6 ADJUSTING AND CLEANING:**

- A. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
- B. Support Adjustment: Provide grout under supports so as to bring piping and equipment to proper level and elevations.
- C. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

**END OF SECTION**

**SECTION 23 06 05**  
**MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL**

**PART 1 – GENERAL**

- 1.1 RELATED DOCUMENTS:** Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

This section is a Division-23 Basic HVAC Materials and Methods section, and is part of each Division-23 HVAC section making reference to pipes and pipe fittings specified herein.

- 1.2 SUMMARY:** Furnish and install complete support, restraint and vibration control systems for all work installed under Division 23 HVAC sections. Work to be responsive to the intent of the International Building Code, latest adopted edition, for the respective seismic zone. Correlate this work with 23 06 03 related to general supports of Mechanical / HVAC systems and equipment.

**1.3 QUALITY ASSURANCE:**

- A. **Manufacturer's Qualifications:** Engage the services of an independent support, restraint and vibration control subcontractor who has the technology, the experience, computer capabilities and manufactured products to prepare the required computations, shop drawings and special devices to meet the minimum requirements described herein.

The support, restraint and vibration control subcontractor shall visit the site during construction at a minimum of two specific periods.

1. When equipment is set in place, prior to placement of seismic restraint devices for the purposes of directing the contractor in properly locating and installing the approved devices.
2. At the completion of the project, prior to final mechanical inspection, for the purpose of verifying the correctness of the support, restraint and vibration isolation device installation and preparing certification of the vibration-isolation work.

The support, restraint, vibration control subcontractor shall exercise the quality control for this work and shall include, but not be limited to instructions direct to the Mechanical (Division-23 and Division-33) Contractor concerning:

Anchoring of all mechanical equipment.

Vibration mounting of equipment.

Equipment base coordination with restraint requirements.

Snubbing of equipment.

Bracing and anchoring of ductwork, piping and conduit.

Provision for vibration of piping.

Concrete and/or steel pads or bases to assure proper mounting of restraints and isolators.

Vibration isolation of exhaust fans, ventilation fans, other rotating equipment.

The subcontractor shall be responsible for identifying the need for the size and location of steel sole plates and their attachment to structural steel or concrete.

The subcontractor shall certify in writing that he has inspected the installation and that all isolation, anchors and seismic restraint materials are installed correctly and functioning properly. Certification shall be provided after all corrective work has been completed.

- 1.4 SUBMITTALS:** Submittal data is required and shall consist of computations, vibration isolation selection, equipment anchors, anchor bolt sizes, supports, seismic restraints, sole plate data, restraint locations and type of restraints.

Submittal data shall identify dimensions, load deflection data, center of gravity, standard connections, manufacturer's recommendations, behavior problems including vibrations, thermal expansion, building expansion joints, etc., associated with equipment, ductwork, piping and conduit.

Calculations need not be submitted when restraint devices for piping, conduit and ductwork are proposed in accordance with the SMACNA Guidelines for Seismic Restraints.

Selection of isolator anchors and restraints shall be clearly made known along with the basis for selection so that proposed systems can be reviewed.

Calculations furnished for anchors, anchor bolts, sole plates and other support steel for restraining devices shall be signed and stamped by an engineer licensed in the State of Utah.

## **1.5 REFERENCES:**

### **A. Codes and Standards:**

International Building Codes	Latest Adopted Edition
NFPA bulletin 90A,	Latest Adopted Edition
UL Standard 181	Latest Adopted Edition
National Electric Code	Latest Adopted Edition

Guidelines for seismic restraint of Mechanical Systems and Plumbing Piping Systems. Published by the Sheet Metal Industry Fund of Los Angeles, California, and the Plumbing and Piping Industry Council, Inc., Los Angeles, California.

## **PART 2 - PRODUCTS**

- 2.1 MATERIALS - PRODUCTS:** Restraint devices shall be especially designed to resist system induced forces in all directions.

- A. Snubbers:** Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer neoprene (bridge bearing neoprene) to protect equipment. Restraints shall allow a maximum of 1/4" before engaging and shall not interfere in normal starting or stopping operation. Housing shall allow for visual inspection to determine clearances during system operation. Restraints shall be field adjustable and be positioned for up to 1/4" clearance both horizontally and vertically. Mountings and snubbers are to be manufactured under a Quality Assurance (QA) Program.
- B. Snubbers and Isolator Combination Devices:** Combination unitized devices may be used

where equipment isolation is required. They shall include the requirements listed for snubbers. Isolation portion shall be stable spring type with combination leveling bolt and equipment fastening device. Base plate shall have adequate means for bolting to structure. The spring assembly shall be removable and shall fit within a welded steel enclosure.

- C. Piping, Conduit and Duct Restraints: Restraint materials for exposed installation shall be standard fabricated flat steel, angle rod and channel members. Restraint members shall be bolt connected. Cabling materials and methods shall be used only in chases or concealed ceiling spaces.

## **PART 3 – EXECUTION**

### **3.1 RESTRAINT GUIDELINE:**

Guidelines for SMACNA seismic restraints for conduit, piping and ductwork are to serve as the basis for restraint methods. (Exception – Use rigid member bracing and attachment concepts. No cabling shall be used in the restraint systems except as noted.)

- 3.2 SEISMIC RESTRAINT - DUCTWORK:** Ductwork, four feet square and larger in cross sectional area or 26" diameter and larger shall be protected in all places by restraints. Locations shall include, but not be limited to:

- A. At all equipment connections.
- B. At all duct turns and duct run ends (transverse bracing).
- C. Transverse bracing to occur 30'-0" O.C. maximum. Rectangular ducts 61" and larger in either direction may be braced at 32'-0" O.C.
- D. Longitudinal bracing shall occur at 60'-0" O.C. maximum.

A group of ducts may be combined in a larger size frame using the overall dimensions with maximum weight for selection of restraint members.

No bracing is required if the top of the duct is suspended 12" or less from supporting member and attached to the top of the duct.

### **3.3 VIBRATION ISOLATION:**

- A. General: Furnish and install devices to isolate moving equipment from the structure. (Or confirm that equipment may be securely fastened directly to the structure without negative effect.) Review isolation furnished with factory package equipment, require conformance with project criteria.
- B. Basic Criteria: Vibration isolation devices which have natural frequencies approximately 1/10 that of the related driving frequency.
- C. Equipment to Include:
  - Exhaust Fans:
- D. Field Verify: All required devices and installation.

### **3.4 VIBRATION ISOLATION - DUCTWORK AND PIPING:**

- A. Furnish and install devices to isolate all piping and ductwork from other moving equipment. Provide flex connections, spring hangers, grooved joint couplings for pipe, etc., as required.

**END OF SECTION**

**SECTION 23 06 07**  
**MOTORS, DRIVES & ELECTRICAL REQUIREMENTS**

**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 work of this section.
- B. Related Sections: Separate electrical components and materials required for field installation and electrical connections are specified in Division-26 and Division-40.
- C. Reference 26 29 23 for description related to Variable Frequency Drives (VFD)'s. All Variable Frequency Drives shall be furnished by Division 26.

**1.2 SUMMARY:**

- A. This section specifies the basic requirements for motors furnished by Division-23 HVAC and for electrical components which are an integral part of packaged HVAC equipment. Package components include, but are not limited to factory installed motors, starters, and disconnect switches, etc.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for HVAC equipment are noted within these documents.

**1.3 QUALITY ASSURANCE:**

- A. For items with electrical aspects furnished by this Division and these Sections, provide electrical components and materials which are UL labeled and assembled with U.L. listings.

**1.4 SUBMITTALS:**

- A. Submit product data for motors, belts, drives, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification sections. Verify project electrical characteristics with submittal. Confirm suitability for altitude, maintaining full nameplate rating plus service factor. Include this data in maintenance manual in accordance with 23 05 30 "HVAC Operation and Maintenance Manuals".

**1.5 REFERENCES:**

- A. NEMA Standards MG 1: Motors and Generators.
- B. NEMA Standards ICS 2: Industrial Control Devices, Controllers, and Assemblies.
- C. NEMA Standards 250: Enclosures for Electrical Equipment.
- D. NEMA Standards KS 1: Enclosed Switches.
- E. IEEE Standard 519: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
- F. Comply with National Electrical Code (NFPA 70).

## PART 2 - PRODUCTS

### 2.1 MOTORS: See 26 05 74 "Electric Motors" but not less than the following:

- A. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are given in the individual equipment specifications.
1. Torque characteristics shall be sufficient to satisfactorily accelerate and maintain the driven loads.
  2. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range.
  3. Provide two-speed motors with two separate windings for poly-phase motors. Confirm 2-speed starter requirements with Division-26.
  4. Fraction Horsepower Single speed motors shall be of the permanent split capacitor type. (PSC)
  5. Temperature Rating: Minimum rate for 40°C environment with maximum 90°C temperature rise for continuous duty at full load (Class H Insulation for altitude, Class B leads allowed).
  6. Starting Capability: Capable of handling not less than 6 evenly timed/spaced starts per hour, (10 minute cycle time) or more as indicated by the automatic control system,
  7. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors, 1.0 for TEFC motors.
  8. Motor Construction: NEMA Standard MG 1, TEFC, continuous duty, design "B", except design "C" where required for high starting torque. Provide motors rated for "Inverter duty" where motors are fed power from variable frequency drives.
  9. Motor Frames: NEMA Standard No. 48 or 54; T-frame, use driven equipment manufacturer's standards to suit specific application.
  10. Bearings:
    - a. Ball or roller bearings with inner and outer shaft seals. Provide with electrically isolated bearings when the motor is fed power from a variable frequency drive.
    - b. Re-greasable with zerk fittings, except permanently sealed where motor is normally inaccessible for regular maintenance;
    - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust on motor;
    - d. For fractional horsepower, light duty motors, sleeve type bearings are permitted;
  11. Enclosure Type: Totally enclosed fan cooled (TEFC) for wet or harsh/dirty environments. Typical throughout this project. Explosion proof (EP) rating for all installation in hazardous locations.
  12. Overload Protection: Provide motors with built-in thermal overload protection. Where indicated for industrial motor applications, Provide motors with an internal sensing device suitable for signaling and stopping motor at starter.



- 13 Noise Rating: "Quiet"
14. Efficiency: "Premium Energy Efficient" motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, test method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors", in accordance with IEEE Standard 112. Motors used with Variable Frequency Drives shall be compatible and designed for use with Variable Frequency Drives. Any "explosion proof" motor set in a classified area and scheduled for use with a variable frequency drive shall be listed for inverter duty applications.
15. Nameplate: indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.
16. Acceptable Manufacturers: Allis-Chalmers, Baldor, Century, General Electric, Gould, Lincoln, Louis-Allis, Marathon, Reliance, U.S. Motors, Westinghouse.

## **2.2 MOTOR DRIVES:**

- A. Provide fan/motor-compressor/motor drives with cast steel sheaves and V-belts of fabric and rubber construction by Browning, Dodge, or Woods. Match multiple belts and adjust the assembly to properly drive the apparatus and to prevent slippage and undue wear in starting. Design drives for 150 percent or more of the specified motor nameplate rating. Furnish all drives with shaft bushings. Belts shall be A, B or C section belts. Narrow gauge belts are not acceptable. Provide adjustable driver sheaves for motors five horsepower and smaller, adjust drives or replace sheaves (on larger motors) as needed to obtain required driven speeds and system capacities.
- B. Provide shaft to shaft coupled drives for pumps and blowers equivalent to the Dodge "Paraflex" design by Browning, Dodge or Woods.
- C. Provide a removable (for maintenance) galvanized steel guard for each V-belt drive, coupled drive or rotating shaft constructed around an angle iron frame, securely bolted to the floor or apparatus. Design the guard to completely enclose drives and pulleys and be constructed to comply with all safety requirements. Provide hinged access doors not less than 6" x 6" for access to motor and fan shaft for test purposes. For double inlet fans, construct the belt guard cover of 1/2" mesh expanded metal, arranged as not to restrict the air flow into the fan inlet.

## **2.3 VARIABLE FREQUENCY DRIVES:** Reference 26 29 23.

### **END OF SECTION**

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**SECTION 23 11 23**  
**FACILITY NATURAL GAS PIPING**

**PART 1 GENERAL**

**1.01 SECTION INCLUDES**

- A. Furnish all labor, materials, equipment, tools and services required to fully complete all Gas Piping work as is indicated on the drawings and/or specified herein including, but not limited to, the following described items.
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.
  - 6. Mechanical sleeve seals.
  - 7. Grout.
  - 8. Concrete bases.
  - 9. This division is to pay all costs associated with the gas meter that are required by the local gas company/authority.

**1.02 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

**1.03 PERFORMANCE REQUIREMENTS**

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
- B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig but not more than 2 psig.
- C. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

**1.04 SUBMITTALS**

- A. Product Data: For each type of the following:
  - 1. Piping specialties.

2. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  3. Pressure regulators. Indicate pressure ratings and capacities.
  4. Dielectric fittings.
  5. Dielectric fittings.
  6. Mechanical sleeve seals.
  7. Escutcheons.
- B. Shop Drawings: For facility natural-gas piping layout. Include plans, piping layout and elevations, sections, and details for fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to building structure. Detail location of anchors, alignment guides, and expansion joints and loops.
1. Shop Drawing Scale: 1/4 inch per foot.
- C. Delegated-Design Submittal: For natural-gas piping and equipment indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of seismic restraints.
  2. Design Calculations: Calculate requirements for selecting seismic restraints.
- D. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.
- E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.
- F. Qualification Data: For qualified professional engineer.
- G. Welding certificates.
- H. Field quality-control reports.
- I. Operation and Maintenance Data: For pressure regulators to include in emergency, operation, and maintenance manuals.

### **1.05 QUALITY ASSURANCE**

- A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### **1.06 DELIVERY, STORAGE, AND HANDLING**

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- D. Protect stored PE pipes and valves from direct sunlight.

## **1.07 COORDINATION**

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

## **PART 2 PRODUCTS**

### **2.01 PIPES, TUBES, AND FITTINGS**

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
- B. PE Pipe: ASTM D 2513, SDR 11.
  - 1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  - 2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 3. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Lyall, R. W. & Company, Inc.
      - 2) Mueller Co.; Gas Products Div.

- 3) Perfection Corporation; a subsidiary of American Meter Company.
- b. PE body with molded-in, stainless-steel support ring.
- c. Buna-nitrile seals.
- d. Acetal collets.
- e. Electro-zinc-plated steel stiffener.
- 4. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Lyall, R. W. & Company, Inc.
    - 2) Mueller Co.; Gas Products Div.
    - 3) Perfection Corporation; a subsidiary of American Meter Company.
  - b. Fiber-reinforced plastic body.
  - c. PE body tube.
  - d. Buna-nitrile seals.
  - e. Acetal collets.
  - f. Stainless-steel bolts, nuts, and washers.
- 5. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Dresser Piping Specialties; Division of Dresser, Inc.
    - 2) Smith-Blair, Inc.
  - b. Stainless-steel flanges and tube with epoxy finish.
  - c. Buna-nitrile seals.
  - d. Stainless-steel bolts, washers, and nuts.
  - e. Factory-installed anode for steel-body couplings installed underground.

## 2.02 PIPING SPECIALTIES

- A. Appliance Flexible Connectors:
  - 1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  - 2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  - 3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  - 4. Corrugated stainless-steel tubing with polymer coating.
  - 5. Operating-Pressure Rating: 0.5 psig.
  - 6. End Fittings: Zinc-coated steel.
  - 7. Threaded Ends: Comply with ASME B1.20.1.
  - 8. Maximum Length: 72 inches.
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
  - 1. Copper-alloy convenience outlet and matching plug connector.
  - 2. Nitrile seals.
  - 3. Hand operated with automatic shutoff when disconnected.
  - 4. For indoor or outdoor applications.
  - 5. Adjustable, retractable restraining cable.

- C. Y-Pattern Strainers:
  - 1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  - 2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  - 3. Strainer Screen: [40] [60]-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  - 4. CWP Rating: 125 psig.
- D. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## **2.03 JOINING MATERIALS**

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## **2.04 MANUAL GAS SHUTOFF VALVES**

- A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125 psig.
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: 125 psig.
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- C. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
  - 1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.
    - c. Lyall, R. W. & Company, Inc.

- d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
- 2. Body: Bronze, complying with ASTM B 584.
- 3. Ball: Chrome-plated brass.
- 4. Stem: Bronze; blowout proof.
- 5. Seats: Reinforced TFE; blowout proof.
- 6. Packing: Separate packnut with adjustable-stem packing threaded ends.
- 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
- 8. CWP Rating: 600 psig.
- 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
- 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- D. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.
    - c. Lyall, R. W. & Company, Inc.
    - d. McDonald, A. Y. Mfg. Co.
    - e. Perfection Corporation; a subsidiary of American Meter Company.
  - 2. Body: Bronze, complying with ASTM B 584.
  - 3. Ball: Chrome-plated bronze.
  - 4. Stem: Bronze; blowout proof.
  - 5. Seats: Reinforced TFE; blowout proof.
  - 6. Packing: Threaded-body packnut design with adjustable-stem packing.
  - 7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 8. CWP Rating: 600 psig.
  - 9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- E. Bronze Plug Valves: MSS SP-78.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Lee Brass Company.
    - b. McDonald, A. Y. Mfg. Co.
  - 2. Body: Bronze, complying with ASTM B 584.
  - 3. Plug: Bronze.
  - 4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.



5. Operator: Square head or lug type with tamperproof feature where indicated.
  6. Pressure Class: 125 psig.
  7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- F. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.
1. McDonald, A. Y. Mfg. Co.
  2. Mueller Co.; Gas Products Div.
  3. Xomox Corporation; a Crane company.
  4. Body: Cast iron, complying with ASTM A 126, Class B.
  5. Plug: Bronze or nickel-plated cast iron.
  6. Seat: Coated with thermoplastic.
  7. Stem Seal: Compatible with natural gas.
  8. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  9. Operator: Square head or lug type with tamperproof feature where indicated.
  10. Pressure Class: 125 psig.
  11. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  12. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- G. Cast-Iron, Lubricated Plug Valves: MSS SP-78.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flowserve.
    - b. Homestead Valve; a division of Olson Technologies, Inc.
    - c. McDonald, A. Y. Mfg. Co.
    - d. Milliken Valve Company.
    - e. Mueller Co.; Gas Products Div.
    - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
  2. Body: Cast iron, complying with ASTM A 126, Class B.
  3. Plug: Bronze or nickel-plated cast iron.
  4. Seat: Coated with thermoplastic.
  5. Stem Seal: Compatible with natural gas.
  6. Ends: Threaded or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  7. Operator: Square head or lug type with tamperproof feature where indicated.
  8. Pressure Class: 125 psig.
  9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

## **2.05 EARTHQUAKE VALVES**

- A. Earthquake Valves: Comply with ASCE 25.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. Vanguard Valves, Inc.
  - 2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 3. Maximum Operating Pressure: 5 psig.
  - 4. Cast-aluminum body with nickel-plated chrome steel internal parts.
  - 5. Nitrile-rubber valve washer.
  - 6. Sight windows for visual indication of valve position.
  - 7. Threaded end connections complying with ASME B1.20.1.
  - 8. Wall mounting bracket with bubble level indicator.
- B. Earthquake Valves: Comply with ASCE 25.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Pacific Seismic Products, Inc.
  - 2. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  - 3. Maximum Operating Pressure: [0.5 psig] [7 psig] [60 psig].
  - 4. Cast-aluminum body with stainless-steel internal parts.
  - 5. Nitrile-rubber, reset-stem o-ring seal.
  - 6. Valve position, open or closed, indicator.
  - 7. Composition valve seat with clapper held by spring or magnet locking mechanism.
  - 8. Level indicator.
  - 9. End Connections: Threaded for valves NPS 2 and smaller; flanged for valves NPS 2-1/2 and larger.

## **2.06 PRESSURE REGULATORS**

- A. General Requirements:
  - 1. Single stage and suitable for natural gas.
  - 2. Steel jacket and corrosion-resistant components.
  - 3. Elevation compensator.
  - 4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.
- B. Line Pressure Regulators: Comply with ANSI Z21.80.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Actaris.
    - b. American Meter Company.
    - c. Eclipse Combustion, Inc.
    - d. Fisher Control Valves and Regulators; Division of Emerson Process Management.

- e. Invensys.
  - f. Maxitrol Company.
  - g. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
  3. Springs: Zinc-plated steel; interchangeable.
  4. Diaphragm Plate: Zinc-plated steel.
  5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
  6. Orifice: Aluminum; interchangeable.
  7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
  8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
  9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
  10. Overpressure Protection Device: Factory mounted on pressure regulator.
  11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
  12. Maximum Inlet Pressure: 5 psig.

## **2.07 DIELECTRIC FITTINGS**

### **A. Dielectric Unions:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - f. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

### **B. Dielectric-Flange Kits:**

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig.
3. Companion-flange assembly for field assembly.

4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

## **2.08 SLEEVES**

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## **2.09 MECHANICAL SLEEVE SEALS**

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
  2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
  3. Pressure Plates: Stainless steel.
  4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

## **2.10 ESCUTCHEONS**

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
  1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
  1. Finish: Polished chrome-plated or rough brass.
- E. One-Piece, Stamped-Steel Escutcheons: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.

- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

## **2.11 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## **2.12 LABELING AND IDENTIFYING**

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

## **PART 3 EXECUTION**

### **3.01 EXAMINATION**

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.02 PREPARATION**

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with the International Fuel Gas Code requirements for prevention of accidental ignition.

### **3.03 OUTDOOR PIPING INSTALLATION**

- A. Comply with NFPA 54 and the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 312000 "Earth Moving" for excavating, trenching, and backfilling.
  - 1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.
- C. Install underground, PE, natural-gas piping according to ASTM D 2774.
- D. Install fittings for changes in direction and branch connections.

- E. Install pressure gage upstream and downstream from each service regulator. Pressure gages are specified in Section 23 0519 "Meters and Gages for HVAC Piping."

### **3.04 INDOOR PIPING INSTALLATION**

- A. Comply with the International Fuel Gas Code for installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade of 2 percent down toward drip and sediment traps.
- I. Install piping free of sags and bends.
- J. Install fittings for changes in direction and branch connections.
- K. Install escutcheons at penetrations of interior walls, ceilings, and floors.
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - d. Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    - f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - g. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with set screw or spring clips.
    - h. Piping in Equipment Rooms: One-piece, cast-brass type.
    - i. Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.

- j. Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.
  - 1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.
- R. Concealed Location Installations: Except as specified below, install concealed natural-gas piping and piping installed under the building in containment conduit constructed of steel pipe with welded joints as described in Part 2. Install a vent pipe from containment conduit to outdoors and terminate with weatherproof vent cap.
  - 1. Above Accessible Ceilings: Natural-gas piping, fittings, valves, and regulators may be installed in accessible spaces without containment conduit.
  - 2. In Floors: Install natural-gas piping with welded or brazed joints and protective coating in cast-in-place concrete floors. Cover piping to be cast in concrete slabs with minimum of 1-1/2 inches of concrete. Piping may not be in physical contact with other metallic structures such as reinforcing rods or electrically neutral conductors. Do not embed piping in concrete slabs containing quick-set additives or cinder aggregate.
  - 3. In Floor Channels: Install natural-gas piping in floor channels. Channels must have cover and be open to space above cover for ventilation.
  - 4. In Walls or Partitions: Protect tubing installed inside partitions or hollow walls from physical damage using steel striker barriers at rigid supports.
    - a. Exception: Tubing passing through partitions or walls does not require striker barriers.
  - 5. Prohibited Locations:
    - a. Do not install natural-gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
    - b. Do not install natural-gas piping in solid walls or partitions.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

- T. Connect branch piping from top or side of horizontal piping.
- U. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage upstream and downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### **3.05 VALVE INSTALLATION**

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

### **3.06 PIPING JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Welded Joints:
  - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  - 2. Bevel plain ends of steel pipe.
  - 3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- D. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- E. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### **3.07 HANGER AND SUPPORT INSTALLATION**

- A. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- B. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- C. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:



1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

### **3.08 CONNECTIONS**

- A. Connect to utility's gas main according to utility's procedures and requirements.
- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### **3.09 LABELING AND IDENTIFYING**

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.
- B. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### **3.10 PAINTING**

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (semigloss).
    - d. Color: Gray.
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    - a. Prime Coat: Quick-drying alkyd metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex (flat).
    - d. Color: Gray.

2. Alkyd System: MPI INT 5.1E.
  - a. Prime Coat: Quick-drying alkyd metal primer.
  - b. Intermediate Coat: Interior alkyd matching topcoat.
  - c. Topcoat: Interior alkyd (flat).
  - d. Color: Gray.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### **3.11 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Use 3000-psi 28-day, compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

### **3.12 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.
- B. Tests and Inspections:
  1. Test, inspect, and purge natural gas according to the International Fuel Gas Code and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### **3.13 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

### **3.14 OUTDOOR PIPING SCHEDULE**

- A. Underground natural-gas piping shall be the following:
  1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.

### **3.15 INDOOR PIPING SCHEDULE**

- A. Aboveground, piping NPS 2 and smaller shall be the following:
  - 1. Steel pipe with wrought-steel fittings and welded or threaded joints.
- B. Aboveground, piping NPS 2-1/2" and larger shall be the following:
  - 1. Steel pipe with wrought-steel fittings and welded joints.
- C. Underground, below building, piping shall be the following:
  - 1. Steel pipe with wrought-steel fittings and welded joints in a vented conduit.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- E. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

### **3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE**

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Bronze plug valve.
- B. Valves for pipe sizes NPS 2-1/2 and larger at service meter shall be one of the following:
  - 1. Bronze plug valve.
  - 2. Cast-iron, nonlubricated plug valve.

**END OF SECTION**

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**SECTION 23 31 00**  
**DUCTWORK**

**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 work of this section.
- B. Division-23 Basic HVAC Materials and Methods Sections apply to work of this section.

**1.2 SUMMARY:**

- A. Extent of metal and high density polypropylene ductwork is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork required for the project include the following:
  - 1. Rectangular
- C. Refer to Section 23 05 93 for system commissioning, testing and balancing.
- D. Refer to Section 23 09 00 for mechanical controls and control dampers (HVAC related only).
- E. Refer to Section 23 31 10 for ductwork accessories.
- F. Refer to Section 23 37 00 for louvers.
- G. Refer to Section 23 82 00 for power ventilators.
- H. Refer to Section 23 90 00 for filters.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of metal and high density polypropylene ductwork products of types, materials, and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects with metal and high density polypropylene ductwork systems work similar to that required for project.

The installer shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Contractor.

All workmen on the project shall carry Utah state licenses as journeymen or apprentice sheet metal workers with additional certification for welders.

**1.4 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical product data and installation instructions for metal and high density polypropylene ductwork materials and products.

- B. Shop Drawings: Submit coordinated scaled layout drawings of metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spacial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.
- C. Record Drawings: At project closeout, submit record drawings of installed metal ductwork and ductwork products, in accordance with requirements of Division-1.
- D. Maintenance Data: Submit maintenance data and parts lists for metal ductwork materials and products. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Division-1.

## **1.5 REFERENCES:**

- A. Codes and Standards:
  - 1. SMACNA Standards: Comply with SMACNA "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.
  - 2. ASHRAE Standards: Comply with ASHRAE Handbook, Equipment Volume, Chapter 1 "Duct Construction", for fabrication and installation of metal ductwork.
  - 3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air-Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems".
  - 4. International Building Code/International Mechanical Code/equivalent Utah Codes: Comply with all sections pertaining to mechanical work.
- B. Field Reference Manual: Have available for reference at project field office, copy of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".

## **1.6 DELIVERY, STORAGE, AND HANDLING:**

- A. Protection: Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

## **PART 2 - PRODUCTS**

### **2.1 DUCTWORK - GENERAL:**

- A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, HVAC Systems and Equipment, 2016 edition, Chapter 19, Duct Construction

### **2.2 SHEET METAL DUCTWORK:**

- A. General: For all rectangular ductwork and fittings construct/fabricate from aluminum, PVC coated galvanized steel or stainless steel. Contractor may choose between aluminum, PVC coated galvanized steel or stainless steel except where specifically directed on the drawings.

If using galvanized sheet steel, provide galvanized sheet steel complying with ASTM A 527, lock forming quality, with G 120 zinc coating in accordance with ASTM A 525; mill phosphatized for exposed locations.

If using stainless steel, fabricate of Type 304 SS or Type 316 SS stainless steel sheet complying with ASTM A-167 with all welded joints and seams. Provide polished No. 4 satin finish for all duct exposed to view, No. 1 finish elsewhere. Protect finished surfaces with mill applied adhesive protective paper through fabrication and installation.

If using aluminum ductwork, aluminum ductwork shall be constructed of 3003-H-14 aluminum using construction for nominal 4" SMACNA rated systems. Seal all transverse joints with duct cement.

- B. Exposed Ductwork Materials: Provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Installation of exposed ductwork shall be laid out in advance and submitted for review. Ductwork shall be hung straight and uniform, points shall be true, and seams shall show continuity.
- C. Note a special requirement for hangers and supports for process areas. Project rejects strap hangers for ductwork. Make angle, insert, or clamp attachment to structure and hang suspended duct with rod or angle iron verticals and angle, channel or Unistrut horizontals. Brace and restrain ductwork as for piping with rigid assemblies. Do not use a cabling system for such duty.

## **2.3 FITTINGS AND FABRICATION:**

- A. Fittings: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section.
- B. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.
- C. Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Duct Accessories" for accessory requirements.
- D. Offset, transition, and adapt ductwork to structural obstacles and work of other trades in a coordinated effort. Layout work to avoid conflict with piping, etc. With review of conditions, teardrop around conflicting piping, lights, etc., all at no added cost to the project.

## **2.3 MISCELLANEOUS DUCTWORK MATERIALS:**

- A. General: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

- B. Duct Sealing Compound for metal ductwork: Use a U.L. listed, fiber reinforced, water based adhesive duct sealing compound by Foster, Hard cast, United-McGill, Nova, Miracle, 3M, Duct mate, Duro Dyne. Verify that the material is listed for use in a moist, corrosive environment compatible with duct material. Follow manufacturer's directions for joint cleaning and preparation; seal all duct and plenum joints prior to and during assembly. Use mastics that will not weep if the duct is warmed above room temperature.

## **PART 3 – EXECUTION**

### **3.1 INSPECTION:**

- A. General: Examine areas and conditions under which metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

### **3.2 INSTALLATION OF METAL DUCTWORK:**

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight (5% leakage for systems rated 3" and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8" misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true to shape and to prevent buckling. Support vertical ducts at every floor.

All necessary allowance and provisions shall be made in the installation of sheet metal ducts for the structural conditions of the building, and ducts shall be transformed or divided as may be required. Whenever this is necessary, the required area shall be maintained. All of these changes, however, must be approved and installed as directed at project. During the installation, the open ends of ducts shall be protected to prevent debris and dirt from entering.

- B. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- C. Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to 1/2" where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1" clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- D. Electrical Equipment Spaces: Except as indicated, do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures. Maintain clearances above of and in front of electrical panels.
- E. Ducts at Structural and Architectural Penetrations: Where ducts are shown connecting to



or passing through concrete, gypsum board, masonry openings and along edges of all plenums at floors and walls, provide a continuous 2" x 2-1/8" stainless steel angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Round high velocity ducts in vertical chases shall be supported with rolled angle rings. Close openings between duct and structure.

- F. Cross Breaking: Rectangular sheet metal ducts shall be cross broken or rolled rib reinforced on the four sides of each 4-foot panel. All vertical and horizontal sheet metal barriers, duct offsets, elbows, as well as 4-foot panels of straight sections of ducts shall be cross broken. Cross breaking shall be applied to the sheet metal between the standing seams or reinforcing angles; the center of cross break shall be of the required height to assure surfaces being rigid. Larger ducts shall include intermediate reinforcing angles or members to stiffen the panel faces.
- G. Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- H. Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards.

Related to final installation cleanliness, damp wipe all ductwork on installation. Cap open duct ends, cover fan inlets, vacuum fan plenums and related installation before starting fans. Run fans only with filters in place.

### **3.4 HANGERS AND SUPPORTS FOR METAL DUCTWORK.**

- A. It is essential that all ducts shall be rigidly supported. Hangers for low velocity ducts up to 18" in width shall be placed on not more than 10' centers.

Low velocity ducts 19" through 35" in width and greater shall be supported on not more than 5' centers. Where vertical ducts pass through floors or roofs, heavy supporting angles shall be attached to ducts, and to structure. Angles shall be of sufficient size to support the ductwork rigidly and shall be placed on at least two sides of the duct.

- B. For rectangular ducts 36" and greater in width, construct hangers with all-thread rods and aluminum channel, galvanized iron channel, or Unistrut sections, minimum dimension 2" x 2" x 1/8".
- C. Ductwork Support Materials for ductwork in Process Areas: Provide 316 stainless steel fasteners, anchors, and rods, washers, nuts and provide 316 stainless steel or 6061-T6 aluminum alloy angles for support of ductwork in process areas. Do not use straps.
- D. Supporting Dampers: Parallel and opposed blade motor operated dampers shall be supported by reinforcing the ductwork or sheet metal walls at the damper locations to carry the weight of the dampers and the force exerted on the dampers due to air pressure, or shall be supported independent of ductwork from the ceiling or floor, as conditions at the site determine.

- 3.5 CONNECTIONS:** All duct joints, transverse and longitudinal, shall be made airtight by coating joints with duct sealing compound before joining, and then sealing the joint with one layer of "Glass Fab" reinforcing tape set in a coating of the compound. Tape and sealant shall not exceed a flame spread of 25 or a smoke development of 50.

- 3.6 WELDED JOINTS:** Welded metal ductwork shall have either an angle or a piece of 1/8"

steel bar behind each weld to allow lying of a neat and continuous bead.

### **3.7 FIELD QUALITY CONTROL:**

- A. Leakage Tests: After each duct system which is constructed for duct classes over 3" is completed, test for duct leakage in accordance with SMACNA HVAC Air Duct Leakage Test Manual. Air leaks which are in excess of that required to bubble the soap suds (that is, actually blow the suds away) shall be sealed by additional taping and caulking to reduce the leakage to a rate not to exceed slow bubbles forming. Repair leaks and repeat tests until total leakage conforms with Chart of Figure 4-1, Seal Class A, Leakage Class 3 for round/oval, 6 for rectangular.
- B. Allow 24 hours for the HDPE ductwork sealant to cure after final assembly before testing the duct system. Additional curing time may be required in high ambient conditions.

### **3.8 EQUIPMENT CONNECTION:**

- A. General: Connect metal and high density polypropylene ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors where indicated.

### **3.9 ADJUSTING AND CLEANING:**

- A. Clean ductwork internally of dust and debris, as follows: With filters in place where applicable, operate the fans at full capacity to blow out dirt and debris from ducts. If it is not practical to use the main supply blower for this test, the ducts may be blown out in sections by a portable fan.
- B. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- C. Balancing:
  - 1. Refer to Section 23 05 93 section "Testing, Adjusting and Balancing" for air distribution balancing of metal or high density propylene ductwork; not work of this section. However, the Sheet Metal Contractor shall participate fully in this work. Seal any leaks in ductwork that become apparent in balancing process.
  - 2. If specified conditions cannot be obtained due to deficiencies in equipment performance or improper installation or workmanship, the Mechanical Contractor and his subcontractors shall make any changes necessary to obtain the specified conditions.

**END OF SECTION**

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**SECTION 23 31 10**  
**DUCTWORK ACCESSORIES**

**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 work of this section.
- B. Division-23 Basic HVAC Materials and Methods sections apply to work of this section.

**1.2 SUMMARY:**

- A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.
- B. Types of ductwork accessories required for project include the following:
  - 1. Duct hardware.
  - 2. Flexible connections.
- C. Refer to 23 05 93 for testing, adjusting, and balancing of ductwork accessories; not work of this section.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

**1.4 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.
- B. Shop Drawings: Submit manufacturer's assembly type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division-1.

**1.5 REFERENCES:**

- A. Codes and Standards:
  - 1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible".
  - 2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.

3. UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers".
4. NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

## **1.6 DELIVERY, STORAGE AND HANDLING:**

- A. Protection: Protect shop-fabricated and factory-fabricated accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.
- B. Storage: Where possible, store accessories inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

## **PART 2 - PRODUCTS**

### **2.1 DUCT HARDWARE:**

- A. General: Provide duct hardware, typically of one manufacturer, for all items on project, for the following:
  1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, cover, for instrument tests. Ventlok No. 699 closures shall be provided and installed for each test hole, with sufficient neck length to penetrate the insulation.
- B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
  1. Ventfabrics, Inc.
  2. Young Regulator Co.

### **2.2 FLEXIBLE CONNECTIONS:**

- A. Extent of Work: Provide flexible connections between ductwork and equipment, such as at fan inlets and discharges, and at other places indicated on the drawings or called for by note or specification.
- B. Non-Corrosive Environment or Airstream: For system pressures up to 5" w.c, provide material of heavy waterproof woven glass fabric double coated with neoprene or Hypalon equivalent to "Ventglas" for interior locations and "Ventlon" for exterior locations, fabric not less than 3-1/4" wide clamped between strips of 24 gauge stainless steel or 20 gauge aluminum alloy. Material by Ventfabrics, Inc., Chicago, Ill.
- C. Corrosive Environments or Airstream: Provide material of heavy waterproof woven fiberglass fabric coated with Teflon equivalent to "Ventel" by Ventfabrics, Inc., Chicago, Ill.

By nature, the material is slippery and requires rigid clamping in the field installation. Install with the coated side to the corrosive air stream. Clamp the material into a stainless steel edging or hinge with a folded fabric edge. Be careful in securing the clamped fabric to the fan or duct as to not penetrate or disturb any protective coatings or surfaces.

## **PART 3 – EXECUTION**

### **3.1 INSPECTION:**

- A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

### **3.2 INSTALLATION OF DUCTWORK ACCESSORIES:**

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- C. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

### **3.3 FIELD QUALITY CONTROL:**

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leak proof performance.

### **3.4 ADJUSTING AND CLEANING:**

- A. Adjusting: Adjust ductwork accessories for proper settings

Label access doors in accordance with Division-23 section "Mechanical Identification".

Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

**END OF SECTION**

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**SECTION 23 61 00**  
**PACKAGED HVAC EQUIPMENT**

**PART 1 - GENERAL**

**1.1 GENERAL MECHANICAL REQUIREMENTS:**

- A. All pertinent sections of Section 23 05 00 - General HVAC Requirements are a part of the work described in this section.

**1.2 SUMMARY:**

- A. This section specifies:
  - 1. Wall Mounted Air Conditioning Units

**1.3 STANDARDS:**

- A. Uniform Building Code/International Mechanical Code
- B. Local Codes and Ordinances
- C. State Pressure Vessel Regulations
- D. EPA Requirements.
- E. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- F. ANSI/ASHRAE 90A - Energy Conservation in new Building Design.
- G. ARI 370 - Sound Rating of Large Refrigeration and Air-conditioning Equipment.
- H. ARI 360 - Unitary Air-Conditioning Equipment.

**1.4 SHOP DRAWINGS/SUBMITTALS:**

- A. Submit a list of all materials to be used indicating brand or source, type and service.
- B. Submit shop drawings for all equipment including shop drawing showing proposed sizes, capacities, accessories, manufacturer and model numbers, wiring diagrams, etc.

**1.5 CONTRACTOR QUALIFICATION:**

- A. The Piping Contractor for this work shall be licensed as a firm in the Contractor state of origin and in the state where the work is performed.
- B. The Subcontractor shall have a publicly registered bonding capacity of sufficient amount to cover this work and all other work in progress by the Subcontractor.
- C. All workmen employed in the project shall carry state licenses as journeyman or apprentice pipe fitters with additional certification for welders.

## **1.6 SCOPE OF THE WORK:**

- A. Furnish and install all refrigeration equipment and related work to effect a complete installation.
  - 1. Provide and install Refrigeration Equipment as indicated on the drawings.
  - 2. Other work indicated on the drawings.

## **1.7 INSTRUCTION OF OWNER'S PERSONNEL:**

- A. Purpose is to provide a transition of the systems from the Contractor to the Owner, leaving the Owner's personnel familiar with and well qualified to operate and maintain the systems.
- B. Instruction to cover purpose and function of each system and its components, to show proper operating technique, to show proper maintenance technique.

## **1.8 WARRANTIES:** See Section 23 05 00.

## **PART 2 – MATERIALS AND METHODS**

### **2.1 WALL MOUNTED AIR CONDITIONING UNIT (WAC-1 & 2)**

- A. GENERAL: Provide self-contained, factory-assembled and tested, wall mounted, horizontal discharge supply and return, single-piece, 3 stage cooling unit with electric heat and full outside air economizer suitable for outdoor use. Contained within the unit enclosure shall be all factory wiring, piping, controls, refrigerant charge (R-454B), and special features required prior to field start-up.
- B. PERFORMANCE:
  - 1. See Equipment Schedule.
- C. UNIT CABINET:
  - 1. Unit cabinet shall be constructed of minimum 16 gauge zinc-coated galvanized steel, bonderize and coated with baked enamel or satin beige polyester finish on all externally exposed surfaces and interior panels which shall allow it to withstand a minimum of 1000 hours of salt spray exposure per ASTM B117-03.
  - 2. The fan cabinet interior shall be insulated with a minimum 1/2-in thick, closed cell foam insulation with acrylic or neoprene coating on the air side.
  - 3. The evaporator cooling section shall be insulated with a minimum 1/2-in thick, 2 lb. closed cell foam insulation with acrylic or neoprene coating on the air side.
  - 4. Cabinet panels shall be easily removable for servicing.
  - 5. Cabinet shall include a sloped top and built-in mounting flanges. Slots or holes shall be provided in the unit to facilitate transporting unit to location of installation.

6. Unit shall have a factory-installed, sloped stainless steel condensate drain pan, providing a minimum 3/4 in. connection with both vertical and horizontal drains and shall comply with ASHRAE 62.
7. Unit shall have factory-installed filter access panel to provide filter access with tool-less removal.
8. Unit shall have standard single point power connection point.

D. FANS:

1. Indoor blower (evaporator fans) shall be of the direct-driven, EC Motor Plenum fan. Impeller blades shall be made from aluminum with steel frame construction and shall be dynamically balanced.
2. Condenser fan shall be of the direct-driven propeller type and shall discharge air horizontally.

E. COMPRESSOR:

1. The compressors shall be scroll type with one 2-stage compressor and one single stage compressor.

F. COILS:

1. Evaporator and condenser coils shall have aluminum plate fins mechanically bonded to seamless copper tubes with all joints brazed. Coils shall be provided with a corrosive resistant coating.
2. Tube sheet openings shall be belled to prevent tube wear.
3. Evaporator coil shall be of the full-face active design.

G. REFRIGERANT COMPONENTS: Each of the two refrigerant circuits shall include:

1. Refrigerant strainer.
2. Sight Glass.
3. Expansion Valve.
4. Service gauge connections on suction, discharge, and liquid lines.
5. Suction and liquid access valves.
6. Filter drier.

H. FILTER SECTION:

1. Filter section shall consist of factory-installed low-velocity, throwaway, 2-in. thick, pleated filters of commercially available sizes (Farr 30-30 or equal).

2. Filter face velocity shall not exceed 300 fpm at nominal airflows.
3. Filters shall be accessible through an access panel with 'no-tool' removal.
4. Provide dirty filter indicator switch.

I. CONTROLS AND SAFETIES:

1. Unit Controls: Furnish unit with factory wired on-board PLC and a remote mounted PGDx touchscreen temperature and humidity controller. Furnish unit with the optional Free Cooling Economizer and all associated controls. Furnish unit with optional factory wired electric heat package and all associated controls.
2. Safeties:
  - a. Unit shall incorporate a solid-state compressor protector which provides anti-cycle reset capability at the space temperature controller, should any of the following standard safety devices trip and shut off compressor.
    - 1) Compressor over temperature, over current.
    - 2) Loss-of-charge/low-pressure switch with automatic reset.
    - 3) Freeze-protection thermostat, evaporator coil.
    - 4) High-pressure switch. The lockout protection shall be easily disconnected at the control board, if necessary.

J. ELECTRICAL REQUIREMENTS:

1. All unit power wiring shall enter unit cabinet at a single factory-predrilled location. The air conditioner shall have a factory installed disconnect.

K. MOTORS:

1. Compressor motors shall be cooled by refrigerant passing through motor windings and shall have line break thermal and current overload protection.
2. Evaporative fan motor shall be electrically commutated with sealed, permanently lubricated, ball-bearings, temperature protection, soft start and an integrated PID controller. Maximum 1100 RPM.
3. Condenser-fan motor shall be totally enclosed, electrically commutated with sealed, permanently lubricated, ball-bearings, temperature protection, soft start and an integrated PID controller. Maximum 1100 RPM.

**L. SPECIAL FEATURES:**

1. Service: Air conditioning unit shall be equipped with hinged access panel for the filter, compressors(s), evaporator fan, and control box areas. Filter hinged access panels permit tool-less entry by removing and discarding screws. Each external hinged access panel shall be permanently attached to the air conditioning unit and equipped with a retainer for service convenience. The electrical control box, including the low voltage compartment, shall be accessible from the front of the air conditioner.
2. Fused disconnect switch: Provide fused disconnect switch factory-installed, internally-mounted. NEC and UL approved fused switch shall provide unit power shutoff. The control access door shall be interlocked with the fused disconnect. The disconnect switch must be in the OFF position to open the control box access door. Shall be accessible from outside the unit and shall provide power off lockout capability.
3. Furnish unit with factory supply and return grilles with brushed aluminum finish.

**M. ACCEPTABLE MANUFACTURERS:**

1. Subject to compliance with requirements, provide air conditioning unit from:
  - a. Bard MEGA-TEC
  - b. Engineer approved equal.

**PART 3 - EXECUTION**

**3.1 INSTALLATION OF WALL MOUNTED AIR CONDITIONING UNITS:**

- A. General: Install unit where indicated, in accordance with equipment manufacturer's published installation instructions, and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.
- B. Coordination: Coordinate with other work, including wall construction, wall openings and electrical as necessary to interface installation of units with other work.
- C. Access: Provide access space around units for service as indicated, but in no case less than that recommended by the manufacturer.
- D. Support: Securely anchor units to the wall.

- E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.
  - 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.
- F. Duct Connections: Refer to Division-23 Sections Air Distribution sections. Provide ductwork sleeves connecting to unit supply and return air openings as indicated on the drawings in preparation for insertion of unit supply air diffuser and return air grille.

### **3.2 DUCTWORK - GENERAL:**

- A. Standards: All duct fabrications shall comply with standards and techniques detailed by SMACNA "Duct Construction Manuals" for the appropriate pressure class, and with the ASHRAE Handbook, HVAC Systems and Equipment, 2016 edition, Chapter 19, Duct Construction.
- B. Sheet Metal: Fabricate ductwork sleeves from galvanized steel, in gauges corresponding to the SMACNA recommendations.
- C. Provide galvanized sheet steel complying with ASTM A 527, lockforming quality, with G 120 zinc coating in accordance with ASTM A 525.
- D. Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2". Fasten to duct and substrate.
- E. Ducts at Structural and Architectural Penetrations: Where ducts are shown connecting to masonry openings, provide a continuous 2" x 2-1/8" stainless steel angle iron which shall be bolted to the construction and made airtight to the same by applying caulking compound. Sheet metal in these locations shall be bolted to the angle iron. Close openings between duct and structure.
- F. Grounding: Provide positive equipment ground for wall mounted air conditioning unit components.

**END OF SECTION**

**SECTION 23 76 00**  
**TERMINAL ELECTRIC HEAT TRANSFER UNITS**

**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 work of this section.
- B. Division-23 Motors Drives and Electrical Requirements for Mechanical Systems, General Mechanical Requirements, and General Pipes and Fittings sections apply to work of this section.

**1.2 SUMMARY:**

- A. Types of terminal units required for project include the following:
  - 1. Electric Wall Heater

**PART 2 - PRODUCTS**

**2.1 ELECTRIC WALL HEATERS: (EH)**

- A. Cabinet constructed of steel with epoxy / polyester powder coat finish. With adjustable louvers.
- B. Safeties and Controls:
  - 1. High temperature control with automatic reset.
  - 2. Built-in tamper proof thermostat.
  - 3. Fan delay to purge heater of residual heat.
- C. Aluminum-finned, copper clad steel sheath heating element
- D. See equipment schedules on drawings for supply voltage.
- E. Appropriate mounting brackets for recessed mount.
- F. Manufacturer: Subject to compliance with requirements, provide electric wall heaters of one of the following:
  - 1. Reznor
  - 2. Markel Prod. Co.,
  - 3. Raywall,
  - 4. Berko, Marley Electric Co.,
  - 5. QMark, Marley Electric Co.,
  - 6. Brasch Manufacturing Co.
  - 7. Indeeco
  - 8. Heatrex

## **PART 3 - EXECUTION**

### **3.1 INSPECTION:**

- A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

### **3.2 INSTALLATION OF TERMINAL HEAT TRANSFER UNITS:**

- A. General: Install heaters as indicated, and in accordance with manufacturer's installation instructions.
- B. Locate heaters where indicated.
- C. Provide and install hangers and supports for heater.

### **3.3 ELECTRICAL WIRING:**

- A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted.

### **3.4 ADJUSTING AND CLEANING:**

- A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.
- B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

**END OF SECTION**



**SECTION 23 82 00**  
**POWER VENTILATORS**

**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 work of this section.
- B. Division-23 General Mechanical Requirements sections apply to work of this section.
- C. See Section 23 06 07 Motors, Drives and Electrical Requirements for Mechanical Work.

**1.2 SUMMARY:**

- A. Extent of power and gravity ventilator work required by this section is indicated on drawings and schedules, and by requirements of this section.
- B. Types of power and gravity ventilators specified in this section include the following:
  - 1. Centrifugal Rooftop Mounted Exhaust Fans.
- C. Refer to Division 23, Section 23 05 93 "System Commissioning, Testing and Balancing" for balancing of power and gravity ventilators; not work of this section.
- D. Refer to Division-23 and 40 temperature control and instrumentation systems sections for control work required in conjunction with power and gravity ventilators; not work of this section.
- E. Refer to Division-26 sections for the following work; not work of this section.
  - 1. Power supply wiring from power source to power connection on ventilators. Include starters, disconnects, and required electrical devices, except where specified as furnished, or factory installed, by manufacturer.
  - 2. Interlock wiring between ventilators; and between ventilators and field installed control devices as shown in Division-26.

Interlock wiring specified as factory installed is work of this section.

**1.3 QUALITY ASSURANCE:**

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of power and gravity ventilators, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

#### **1.4 SUBMITTALS:**

- A. Product Data: Submit manufacturer's technical data for power and gravity ventilators, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions.
- B. Shop Drawings: Submit assembly type shop drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details.
- C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to power ventilators. Submit manufacturer's ladder type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory installed and portions to be field installed.
- D. Maintenance Data: Submit maintenance data and parts list for each type of power and gravity ventilator, accessory, and control. Include this data, product data, shop drawings, and wiring diagrams in maintenance manual; in accordance with requirements of Division-23.

#### **1.5 REFERENCES:**

- A. Codes and Standards:
  - 1. AMCA Compliance: Provide power ventilators which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Rating Seal.
  - 2. UL Compliance: Provide power ventilators which are listed by UL and have UL label affixed.
  - 3. NEMA Compliance: Provide motors and electrical accessories complying with NEMA standards.

### **PART 2 – PRODUCTS**

#### **2.1 SQUARE IN-LINE CENTRIFUGAL TYPE VENTILATION FAN (VF-1):**

- A. Extent of Work: Furnish and install required, belt driven centrifugal square in-line type fan, complete with fan, motor, inlet and discharge flanges.
- B. General: Fan shall be listed by Underwriters Laboratories (UL 705). Fans shall bear the AMCA certified ratings seal for sound and air performance.
- C. Construction: Fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Provide fan assembly with pivoting motor plate utilizing a threaded L-bolt design for positive belt tensioning. Housing shall be pre-drilled to accommodate universal feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate.

- D. Coating: All steel fan components shall be coated with conventional spray applied phenolic epoxy coating inside and out. Each component shall be subject to a five stage environmentally friendly wash system, followed by a minimum 2 mil thick phenolic resin finish. Paint must exceed 500 minimum hour salt spray under ASTM B117 test method.
- E. Wheel shall be non-sparking centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.
- F. Motor: Motor shall be heavy duty type, totally enclosed fan cooled with permanently lubricated sealed ball bearings and furnished at the specified voltage and phase.
- G. Bearings: Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty re-greasable ball type in a pillow block cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
- H. Belts and Drives: Belt(s) shall be oil and heat resistant, non static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive shall be factory set to the specified fan RPM.
- I. Approved Manufacturers: Subject to compliance with the specifications provide equipment from one of the following manufacturers.
  - 1. Acme
  - 2. Cook
  - 3. Pace
  - 4. Greenheck
  - 5. Penn
  - 6. Twin-City

## **PART 3 - GENERAL**

### **3.1 INSPECTION:**

- A. General: Examine areas and conditions under which power ventilators are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION OF POWER VENTILATORS AND FANS:**

- A. General: Except as otherwise indicated or specified, install power ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that products serve the intended function.
- B. Coordinate ventilator work with work of roofs, walls and ceilings, as necessary for proper interfacing.
- C. Ductwork: Refer to Divisions-23 sections 23 31 00 "Ductwork" and 23 31 10 "Ductwork Accessories." Connect ducts to ventilators in accordance with manufacturer's installation instructions.
- D. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory mounted.
- E. Remove shipping bolts and temporary supports within ventilators. Adjust dampers for free operation.

### **3.3 FIELD QUALITY CONTROL:**

- A. Testing: After installation ventilators have been completed, test each ventilator to demonstrate proper operation of unit at performance requirements specified. When possible, field correct malfunctioning units, and then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

### **3.4 ADJUSTING AND CLEANING:**

- A. Cleaning: Clean factory finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

**END OF SECTION**

**SECTION 26 05 00**  
**ELECTRICAL GENERAL REQUIREMENTS**

**PART 1 – GENERAL**

**1.1 SCOPE**

- A. This Section consists of the Electrical General Requirements and related items necessary to provide complete and operational electrical system(s) indicated within the Contract Documents.

**1.2 APPLICABLE SECTIONS AND REQUIREMENTS**

- A. The General Conditions, Supplementary Conditions, Special Conditions, Alternates and Addenda, applicable drawings, and the technical specifications herein shall apply to all work specified herein.
- B. The CONTRACTOR shall comply with the specifications and accompanying drawings which describe and provide for the furnishing, delivering, installing, testing, and placing in satisfactory and successful operation all equipment, materials, devices, and necessary appurtenances to provide a complete electrical system for power distribution, control, lighting, and auxiliary systems.
- C. State Licensed Contractor - All contractors must have a current state contracting license. The CONTRACTOR shall be licensed as such in the CONTRACTOR state of origin and in the state where the work is performed.
- D. The electrical contractor shall have a licensed Master Electrician assigned to direct the electrical work and to coordinate work with the General Contractor and other trades. Furthermore, a licensed journeyman electrician shall be assigned to supervise the actual performance of all electrical work specified herein.
- E. The licensed journeyman assigned to supervise the performance of all electrical work, shall be required to be on the job site at all times, while electrical work is being performed.

**1.3 CONTRACT DOCUMENTS**

- A. Contract documents consist of drawings, specifications, and other documents issued by the ENGINEER. Each is complementary and requirements shown, written or reasonably inferred there from on one is considered as written, shown or implied in all. In the event work is called for in more than one place and is of conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.
- B. The drawings are diagrammatic, intended to indicate the general scope and locations of the work to be installed and are not to be considered as complete in every detail, but shall be followed as closely as actual construction and work of other contractors will permit.

- C. Data given herein and on drawings are as exact as could be secured, but their extreme accuracy is not guaranteed. Drawings and specifications are for the assistance and guidance of the CONTRACTOR; but exact locations, distances, and levels will be governed by actual conditions, and the CONTRACTOR is to verify all dimensions given on the drawings, and to report any discrepancy or inconsistency to the ENGINEER before commencing with the work.
- D. The CONTRACTOR shall install all work indicated and/or specified herein, complete to perform the function intended without additional cost. Raceway and conductors to panels from devices referred to as "home runs" are indicated by pointing in the general direction of panels. Construction shall continue such circuits to the panels as though the routes were completely indicated. Home runs shall be installed from devices to panels as indicated.
- E. Deviations from the drawings required to make work of this contract conform to actual conditions as constructed, or as to work of other contractors, shall be made by the CONTRACTOR at his expense. The ENGINEER reserves the right to make minor changes in the location of equipment and devices without additional charges.
- F. The CONTRACTOR shall familiarize himself with the architectural, structural, and civil/mechanical drawings and shall study drawings and details so that equipment will be properly located and readily accessible. If any conflicts occur necessitating departures from the contract drawings, details of departures and reasons therefore shall be submitted for prior approval.
- G. In any case and at any time, a change in material or location is made necessary by CONTRACTOR's failure to take into account obstacles or the installation of other trades shown, whether on electrical drawings or other drawings, in existence at the time bids were received, such changes shall be made without charge to OWNER.
- H. Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Where drawings are required for these purposes or have to be made from field measurements, they shall be prepared by the CONTRACTOR, Shop Drawings of various contractors shall be coordinated to take into account all obstacles that will interfere with the installation.
- I. Every attempt has been made to indicate the installation and wiring requirements for all equipment to be installed. However, it shall be the CONTRACTOR's responsibility to coordinate with equipment shop drawings and make adjustments necessary including; power and control wiring sizes and counts, breaker sizes, rough-in locations, etc. for actual equipment provided. The contractor shall provide in his bid the conductors and conduits required for the equipment to be installed. The contractor shall reference the mechanical drawings, the P&ID drawings, the control diagrams, the control drawings, the power drawings, the one line diagrams and all schedules. The contractor shall at his expense provide the conduit and conductors for the equipment installation for a complete and functional system.

- J. Every attempt has been made in the drawings to indicate the general installation requirements for the power and control connections for the equipment indicated. However, equipment requirements vary from manufacturer to manufacturer and from date to date for equipment. The responsibility to coordinate the exact requirements of all equipment and install the required systems for these systems shall belong to the contractor, at his expense. No additional costs to the owner shall be incurred for the contractor's failure to coordinate these equipment requirements at the time of bid.
- K. Electrical drawings are diagrammatic in nature and are not intended to show shop drawing style connections, equipment installation coordination or exact conduit and conductor sizes or counts. The contractor shall at his expense coordinate and provide necessary electrical and control components for a complete and functional system. If any conduit, equipment schedule, sizing, capacities, counts, lengths are unclear at the time of bidding or if conflicts exist on the drawings or in the specifications, the owner reserves the right for the installation of the more expensive or the more involved at no additional cost to the owner.

#### 1.4 INFORMATION FOR ENGINEER

- A. Submit the required information in accordance with the General Conditions, Section 00 70 00, and the following requirements.
  - 1. The CONTRACTOR shall check all shop drawings for conformance with Contract Documents before submitting. The CONTRACTOR shall note on shop drawings any changes from items specified listing reasons and giving source of change such as "Approved Equal", "Addendum", or "Change Order". The CONTRACTOR shall be responsible for conformance with drawings and specifications; for dimensions to be confirmed and correlated at the job site: for information that pertains solely to the fabrication processes or the techniques for construction; and coordination of the work with other trades. Receipt or approval of shop drawings by the ENGINEER does not relieve the CONTRACTOR of the responsibility of complying with Contract Documents.
  - 2. All shop drawings (drawings and manufacturer's data) required under each section of this Division 26 shall be submitted at the same time and be bound together in one hard back, three ring binders per copy, properly indexed for the formal submittal. Binder shall be sized to adequately contain all the materials therein and shall be labeled as to the identity of the job and the sub-contractor.
  - 3. Shop drawings shall include functional and descriptive literature of the particular item furnished complete with dimensional drawings, wiring or schematic diagrams, rough-in and installation instructions, knock-out locations, hangers or mounting devices, etc., as required for the proper checking and installation of the equipment. Catalog sheets without any reference made to the particular item will not be acceptable. All special features called for in Contract Documents shall be noted. Where performance test results of a product design are called for in the technical sections of these specifications, test data sheets shall be provided with the shop drawing submittal.

- B. Material Lists: Include manufacturer, type and model number of equipment that will be provided as called for under each section of this Division 26.
- C. Other Information: As required by the ENGINEER.

#### 1.5 CODES, LICENSES AND STANDARDS

- A. Perform work in accordance with best present-day installation and manufacturing practices. Comply with all applicable laws, building and construction codes, and requirements of governmental agencies under whose jurisdiction work is being performed. Unless specifically noted to contrary, conform with and test in accordance with applicable sections of latest revisions of the following codes and standards.
  - 1. American Society for Testing and Materials (ASTM)
  - 2. National Fire Protection Association (NFPA)
  - 3. National Electrical Code (NFPA 70-NEC)
  - 4. Insulated Power Cable Engineers Association (ICEA)
  - 5. Underwriters Laboratories Inc. (UL)
  - 6. American Steel and Iron Institute, "Design Manual on Steel Electrical Raceways"
  - 7. National Electrical Manufacturer's Association (NEMA)
  - 8. National Electrical Contractor's Association (NECA)
  - 9. American National Standards Institute (ANSI)
  - 10. International Building Code (IBC)
  - 11. State of Nevada Electrical, Energy, Building and Safety Codes
  - 12. Institute of Electrical and Electronic Engineers (IEEE)
  - 13. Instrument Society of America
  - 14. Wastewater Treatment Plants (NFPA-820)
  - 15. US Environmental Protection Agency (EPA)
- B. Conflicts Between Above Codes and Standards: The code or standard establishing the more stringent requirements shall be followed.



- C. Conflicts Between Codes and Standards and Specifications and/or Drawings:  
The one establishing the more stringent requirements shall be followed.

## 1.6 MATERIALS AND WORKMANSHIP

- A. Each type of equipment or material shall be the same make and quality. All materials and equipment shall be installed in accordance with the recommendations of the manufacturer as approved by the ENGINEER to conform to the Contract Documents.
- B. The installation shall be accomplished by workmen skilled in the type of work involved.
- C. All materials and equipment furnished and installed shall be of best quality, new, free from defects and meet the standards of NEMA, ICEA, UL, NFPA, IBC, OSHA, NEC, and shall bear their label wherever standards have been established and label service is available. Where materials and equipment are specified by manufacturer's name, the type and quality required is thereby denoted. The ENGINEER shall be afforded every facility, deemed necessary to observe and examine the materials and apparatus being installed to prove their quality.
- D. Workmanship shall be the best quality of its kind for the respective industry crafts and practices, be neat and orderly throughout the project and shall be acceptable in every respect to the ENGINEER. Nothing contained herein shall relieve the CONTRACTOR from making good and perfect work in all details of construction.
- E. The CONTRACTOR shall work in harmony with the ENGINEER and with other contractor's, companies or individuals working in connection with this project. Imperfections or discrepancies by other contractors shall not relieve responsibility of this CONTRACTOR. Store materials orderly and clean up without interference with other trades.

## 1.7 DEFECTIVE EQUIPMENT

- A. If equipment fails to conform to detailed specifications or to operate satisfactorily, the OWNER will have the right to operate equipment until defects are corrected.
  - 1. The OWNER will have the right to operate rejected equipment until it is replaced, without cost for depreciation use or wear.
  - 2. Remove equipment from operation for examination, adjustment, alteration or change only at times approved by the OWNER.

## 1.8 STORAGE AND PROTECTION OF MATERIALS

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work under way, and apparatus against loss or damage.
- B. Materials and apparatus shall be stored with environmental protection and other necessary conditions as recommend or required by the manufacturers'.

## 1.9 RECORD DRAWINGS

- A. The Contract Document drawings will be used by the CONTRACTOR who shall accurately and neatly mark in colored pencil all changes or deviations from the drawings as they are made in the work.
- B. Refer to Section 01 78 50 Project Closeout for additional requirements.

## 1.10 COORDINATION OF CONSTRUCTION

- A. Coordinate work with other contractors, the OWNER, and the ENGINEER to assure orderly and expeditious progress of work. Select order of work and establish schedule of working hours for construction. This is subject to review by the OWNER if the work involved is part of a functioning facility. If such is the case, the CONTRACTOR shall carefully coordinate any disruption of service with the OWNER. Any after hours/weekend outages shall be accommodated at no additional cost to the OWNER.
- B. The electrical work shall be laid out in advance of construction to eliminate unnecessary cutting, drilling, or channeling, etc. Where such cutting and drilling, or channeling becomes necessary for proper installation; perform with care, use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the OWNER. Cutting work of other trades shall be done only with the consent of the CONTRACTOR. Cutting of structural members shall be done only with the written approval of the ENGINEER.
- C. Comply with the following:
  - 1. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
  - 2. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
  - 3. Install systems, materials and equipment giving right-of-way priority to systems required to be installed at a specified slope.

- D. Cooperate with other trades to coordinate locations of electrical devices and apparatus.
- E. Perform for other trades the electrical wiring and connections, for all devices or apparatus where not specified herein or indicated on the drawings. Consult the architectural and mechanical drawings to avoid the location of switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc. Hidden electrical devices and/or connections shall be relocated as directed, at no additional cost to the OWNER.
- F. Where conduit, outlets or apparatus is to be cast in concrete or encased, it must be located and secured by a journeyman or foreman present at the point of installation. He shall check the locations of the electrical items before and after the concrete and masonry installation and shall relocate displaced items at no additional cost.

#### 1.11 USE OF SUBSTITUTES

- A. Equipment and materials are designated by one or more manufacturer's name brands or numbers. It is not the intent of the specifications to exclude other equipment or materials that equal or exceed the standard of those specified. If the CONTRACTOR desires to use substitute equipment or materials, he must submit for written approval as outlined in the General Conditions of the Contract Documents.

#### 1.12 SITE CONDITIONS

- A. Examination of Site: Examination of the site shall be made by the CONTRACTOR, who shall compare it with the drawings and specifications and satisfy himself as to the conditions under which the work is to be performed. He shall, at such time, ascertain and check all conditions which may affect his work. No allowance shall subsequently be made in his behalf for any extra expenses to which he may be put due to failure or neglect on his part to make such examination.
- B. Review of Plans: Review all work indicated on drawings and specified herein with proper authorities responsible for interpreting applicable codes, ENGINEER, and local inspector prior to commencement with construction as listed herein, but not necessarily limited thereto:
  - 1. Visit site prior to executing bid.
  - 2. Verify measurements and locations of field measurements of existing conditions and those developed by construction.
  - 3. Confirm requirements of work at off-site, publicly owned property with local authorities
  - 4. Confirm connection requirements, sizes and layout with local public utilities.

5. Conditions discovered in conflict with intent of drawings and/or specifications must be clarified with ENGINEER prior to execution of work.

#### 1.13 CLEAN-UP

- A. As the work progresses and on a daily basis, the CONTRACTOR shall remove from the premises and surrounding streets, alleys, etc., all rubbish and debris resulting from his operations and shall leave all equipment and material furnished by him absolutely clean and ready for use.

#### 1.14 SUPERVISION:

- A. A competent foreman or superintendent initially approved by the ENGINEER shall be at the site at all times to receive instructions and shall be empowered to act. He shall verify dimensions given on the drawings and report any discrepancies or inconsistencies to the ENGINEER before commencing the work. The ENGINEER, or his representative, will interpret the meaning of the drawings and specifications where questions arise.

#### 1.15 SAFETY REGULATIONS

- A. The CONTRACTOR shall comply with OSHA and all other safety codes required by law and shall furnish and place proper protection for prevention of accidents. He/she shall provide and maintain any necessary construction required to secure safety of life or property during the performance of his/her work, including the maintenance of sufficient lights to secure such protection.

#### 1.16 DISPOSITION OF EXISTING EQUIPMENT REMOVED FROM SERVICE

- A. Existing equipment and materials such as cables, switches, conductors, etc., which are removed and not reused in the new installation shall remain the property of the OWNER. The CONTRACTOR shall deliver such equipment to storage place as directed. Items not wanted by the OWNER shall be removed from the site and disposed of by the CONTRACTOR.

#### 1.17 PERMITS AND FEES

- A. Obtain all permits and pay all fees for inspections, required by code for all the work covered under Division 26 of the specifications. All fees shall be included in the contract price. The CONTRACTOR shall furnish a certificate of approval to the ENGINEER from each inspection authority at completion of the work.

### **PART 2 - PRODUCTS – NOT USED**

### **PART 3 - EXECUTION**

#### 3.1 FIELD DESIGN CHANGES

- A. No field changes, additions, or change in locations shall be made without written approval from the ENGINEER.

### 3.2 EXCAVATION AND BACKFILLING

- A. The CONTRACTOR shall perform all excavation, trenching and backfilling work, and remove all debris in connection with his work. Backfilling shall be done with materials acceptable to the ENGINEER and thoroughly tamped in place. All disturbed surfaces shall be restored to their original condition and properly installed to eliminate any settlement. Inside and outside, backfill shall be in 6-inch layers, compacted to 95% of the "modified protector test".
- B. Perform excavation in a manner to protect walls, footings and other structural members, from being disturbed or damaged in any way.

### 3.3 ROUGH-IN REQUIREMENTS

- A. Architectural, structural and mechanical drawings shall be continually consulted and referred to. Exact placement of sleeves, conduit, and equipment shall be provided for by checking building and equipment dimensions. Equipment requirements and dimensions related there to shall be determined from detailed rough-in dimensions of each piece of equipment shown on Shop Drawings furnished by manufacturer.

### 3.4 CUTTING AND PATCHING CHASES AND OPENINGS

- A. Provide for all required cutting and patching, anchors, openings, slots, chases, etc., in construction for electrical work. Cutting and patching performed under direction of CONTRACTOR and will leave no discernable scars.
- B. The CONTRACTOR shall be responsible for block-outs or demolition work pertaining to the installation of the electrical system.
- C. In Remodeling and/or Addition projects, all salvageable electrical equipment and materials that cannot be integrated into the new electrical network becomes the property of the OWNER. Remove from the premises materials which the OWNER decides not to keep, as directed by the ENGINEER.

### 3.5 WORKMANSHIP

- A. The CONTRACTOR shall be held solely responsible for the proper installation of his work. He shall arrange with the proper contractors for the building in of anchors, etc., and for the leaving of required chases, openings, etc., and shall do all cutting and patching made necessary by his failure or neglect to make such arrangements with others. Any cutting or patching done by this CONTRACTOR shall be subject to the directions of the ENGINEER and shall not be started until approval has been obtained.
- B. All cutting, welding or drilling of concrete or structural members shall be properly reinforced and patched to match as nearly as possible the surrounding work. Before cutting, welding or drilling any concrete or structural member, the CONTRACTOR shall secure the approval of the ENGINEER.

- C. This CONTRACTOR shall assign persons in direct charge of work who are thoroughly experienced in the class of construction work specified herein. All labor shall be performed in a workman like manner by skilled workmen under the supervision of competent foremen.
- D. CONTRACTOR shall periodically remove all debris and waste in order to maintain safe working and operating conditions, and shall dispose of the same in an approved manner. At the completion of work, he shall remove all his rubbish, tools, scaffolds and surplus materials from and about the site, leaving his work clean and the areas ready for occupancy.

### 3.6 SEISMIC RESTRAINT

- A. The International Building Code requires that not only the structure, but also major mechanical and electrical components be designed and installed in a manner which will preclude damage during a seismic event. All electrical equipment shall be securely anchored and seismic braced in accordance with regulations contained in the most recent adopted edition of the IBC, and SMACNA "Guidelines for Seismic Restraints of Electrical Systems".
- B. Units mounted and secured directly to structure shall be provided with connectors of sufficient strength to meet the restraining criteria.
- C. All electrical equipment which is securely anchored (hard mounted) to the building or structure shall have supports designed to withstand lateral and vertical "G" loadings equal to or greater than IBC requirements and SMACNA guidelines.
- D. Shop drawings are required for all equipment anchors, supports and seismic restraints. Submittals shall include weights, dimensions, load/deflection data, center of gravity, standard connections, manufacturer's recommendations, and behavior problems (vibration, thermal, expansion, etc.) associated with equipment so that the final design can be properly reviewed.

### 3.7 TESTS

- A. On completion of the work, the installation shall be tested free from all grounds and short circuits.
- B. Normal feeders, circuits, and service entrance conductors with wire size #2 and larger shall be tested for leakage phase-to-ground and phase-to-phase prior to energizing the electrical system. The CONTRACTOR shall submit a written report to the ENGINEER showing methods and readings taken. Voltage applied for testing shall not exceed two times normal operating voltage.
- C. Submit a record of voltage readings and amp meter readings on all feeders, motor full load amps, outside lighting, and service conductors to the facility. If there are any abnormal conditions, they shall be brought to the attention of the ENGINEER in writing as a part of this submittal.

- D. Refer to Section 26 05 08 Electrical Acceptance Tests for additional requirements.

### 3.8 SUBSTANTIAL AND FINAL COMPLETION

- A. Notify the ENGINEER when work is considered to be complete, in operating condition, and ready for Substantial Completion.
- B. The ENGINEER, after determining that installation is ready for Substantial Completion, will make walkthrough and perform operational tests deemed necessary to determine that provisions of specifications are satisfied and prepare a list of outstanding items.
- C. The OWNER will not accept work nor make final payment to CONTRACTOR until ENGINEER has certified that work of CONTRACTOR is complete and in conformance with specifications and guarantees.
- D. Leave the job in complete order ready for use. All fixtures and equipment shall be tight, fully equipped and completely cleaned. All equipment shall have been operated, checked and approved by the OWNER before the project can be accepted.
- E. At the time of the substantial and final walkthroughs, the project foreman shall accompany the party and remove cover plates, panel and enclosure covers, and other access panels for the ENGINEER, to allow complete observation of the entire electrical system(s).
- F. Notify the ENGINEER when work is considered to be complete, including list of outstanding items, and is ready for Final Completion. Refer to Section 01 70 00 Contract Closeout for additional requirements.

### 3.9 TRAINING

- A. Instruct OWNER's operating personnel in proper operation of the complete electrical system including all electrical equipment, switching, disconnects, panels, controls, etc., during a scheduled training tour for the OWNER's personnel of entire project after Substantial Completion and prior to Final Completion. Confirm complete understanding on part of OWNER's operating personnel. Utilize the Operations and Maintenance Manuals specified elsewhere during the instruction process.

### 3.10 GUARANTEE/WARRANTY

- A. The following guarantee is a part of the specification and shall be binding on the part of the CONTRACTOR and shall be submitted by letter to the OWNER prior to acceptance.

- B. The CONTRACTOR guarantees that this installation complies with the drawings and specifications in all respects, and is free from defects. He agrees to replace or repair, to the satisfaction of the ENGINEER, any part of this installation which may fail or be determined unacceptable within a period of one (1) year after Final Completion.
- C. The CONTRACTOR guarantees that the installation of OWNER furnished equipment is free from defects. He agrees to provide labor to repair or replace to the satisfaction of the ENGINEER any part of his installation of the OWNER furnished equipment (the respective equipment vendor will provide all parts and labor for the equipment), which may fail or be determined to be unacceptable within a period of one (1) year after Final Completion.
- D. Electrical and instrumentation systems and equipment shall not be considered acceptable for Substantial Completion until they have performed in service continuously without malfunction for at least ten (10) days.

**END OF SECTION**



**SECTION 26 05 05**  
**OPERATION AND MAINTENANCE MANUALS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. Division-26 Electrical General Requirements sections apply to work of this section.

**1.2 SUMMARY**

- A. Furnish three sets, two hard bound copies and one electronic copy of bound operation and maintenance manuals. Manuals shall contain descriptive drawings and data which identify equipment installed at the project and detail the procedures and parts required to maintain and repair the equipment. Copies of approved submittals shall be included for all equipment.
- B. Refer to Section 01 34 00 for additional requirements.

**1.3 OPERATION AND MAINTENANCE MANUAL FOR ELECTRICAL AND INSTRUMENTATION SYSTEMS**

- A. General:
  - 1. The "Operating and Maintenance Manual" (Electrical and Instrumentation) is a bound compilation of drawings and data that the owner requires for each building or project. These manuals, complete with drawings and data, shall be furnished to the Owner.
  - 2. The electrical CONTRACTOR has overall responsibility to obtain the necessary data and compile the data as set forth in this specification, including items or equipment purchased by the Owner and delivered to the CONTRACTOR for installation.
  - 3. The number of binders (or "volumes") required will depend on the amount of information to be catalogued. Total "sets" see paragraph 1.2A.
  - 4. Make all information legible and sufficiently marked to indicate the exact size, model, type, etc., of equipment furnished and installed.
- B. Purpose: The Operating and Maintenance Manual is prepared to provide a ready reference to all important pieces of mechanical and electrical equipment installed on the project. It is also to provide the necessary operating and maintenance data for use by service personnel. It is also to provide information required for checking equipment performance or for planning of plant expansion or redesign.

**PART 2 - PRODUCTS**

**2.1 PAGE SIZE:**

- A. All pages shall be standard 8-1/2 x 11 inches size or approximate multiples (preferably 11 x 17 inches) folded to 8-1/2 x 11 inch.

## 2.2 DRAWINGS:

- A. All drawings larger than 8-1/2" x 11" shall be folded and inserted in individual 8-1/2" x 11" manila pockets, which shall have standard three-ring side punching for insertion in the binders. The equipment name, drawing description and number shall be written on the face of each manila pocket.

## 2.3 BINDERS:

- A. Binders shall be Buckram (stiffened fabric), bar-lock type binders with block lettering for sheet size 8-1/2 x 11 inches with 2" to 3-1/2" expandable metal capacity as required for the project. The number of binders, however, shall be based on not filling them beyond 4".

- B. Place the following information on the front cover and backbone:

1. "Operation and Maintenance Manual".
2. Project Name and Number (and volume number if more than one volume).
3. Equipment name and number.
4. ENGINEER's name.
5. General CONTRACTOR's name.
6. Electrical CONTRACTOR's name.

(Items 4 through 6 need not be printed on the backbone.)

## 2.4 CONTENTS AND INDEXING

- A. Manuals shall contain descriptions of the electrical, control, and instrumentation systems in sufficient detail to adequately indicate the type of systems installed and the basic details of their operation.
- B. All purchased equipment data shall be used to designate the sections. Within each section additional indexing of component parts may be required.
- C. Operation and Maintenance Manuals shall contain to the fullest extent all possible information pertinent to the equipment. The arrangement and type of information to be filed shall be as follows:
  1. Copy of purchase order change (if any).
  2. Outline drawings, special construction details, "as-built" electrical wiring and control diagrams with wire and terminal number for panel and field wiring for all major and supplementary systems.
  3. Manufacturer's test or calculated performance data and certified test curves.
  4. Installation, operating, and maintenance instructions, including a complete parts list and sectional drawing with parts identification numbers. Mark with model, size and plan number.

5. Manufacturer's brochure marked to indicate exact equipment purchased. Brochures on component parts supplied by a manufacturer with his equipment, but not manufactured directly by him, shall also be included.
6. The serial numbers of each item of equipment installed are to be listed with the model numbers and plan symbols.
7. Include a Table of Contents. The contents shall be divided with tabbed index dividers into the following suggested parts:
  - Part I Building and System Descriptions
  - Part II Purchased Equipment Data
  - Part III Test Reports and Charts
  - Part IV Start-Up and Operation
  - Part V Preventative Maintenance Recommendations
  - Part VI Software/Programming Data/Program CD's
8. A copy of the approved submittals for each piece of equipment.
9. A copy of all testing reports.
10. Wiring diagrams, marked with model and size and plan symbol.
11. The index shall contain the name and address of the manufacturer and, if different, where replacement and repair parts may be obtained.
12. Copies of developed software, programmed setpoints, screens, etc. on C.D.

**END OF SECTION**

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**SECTION 26 05 07**  
**ELECTRICAL POWER SYSTEM STUDIES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. The electrical equipment manufacturer shall provide electrical power system studies for the project. The studies shall be prepared by the licensed professional electrical engineer of record for the plant. The type and content of each study is specified in the following articles.

**1.2 SUBMITTALS**

- A. Completed electrical power system studies shall be bound and submitted to the ENGINEER.
  - 1. Five (5) printed copies (hardcopies) of the completed study report shall be provided and one (1) copy in Microsoft Word or Adobe Acrobat format.
  - 2. The software database and library used to model the power system shall be submitted in native file format including all updates to the library necessary to complete the model.
- B. The CONTRACTOR shall attach brochures, resumes, references and other information indicating how your firm is qualified to provide the services outlined in this document.
- C. The CONTRACTOR is responsible for compliance with all performance specifications in this proposal. Any deviation from complete compliance must be noted on the performance specification submitted for review and approved before work begins.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. The analysis software shall be SKM Analysis Software or equal meeting all performance specifications.

**2.2 ELECTRICAL POWER SYSTEM STUDIES**

- A. An electrical arc flash hazard analysis, including:
  - 1. The development of an up-to-date electrical system one-line diagram and model to provide staff members with an accurate representation of the installed electrical system.
  - 2. Determination of system operating modes and conditions that can impact short circuit currents and arc flash hazard energy levels.
  - 3. Short circuit and equipment duty study to verify that equipment is rated to safely handle short circuit currents without creating hazardous conditions.
  - 4. Protective device coordination study and review to help ensure proper electrical system reliability and to determine if arc flash hazard energy levels can be reduced.
  - 5. Arc flash hazard analysis study to determine arc flash energy levels and Personal Protective Equipment (PPE).
  - 6. Power System Modeling and Arc Flash Analysis software for ongoing use by the staff members maintaining and updating the system study as the plant changes.

7. Arc flash and safety program implementation software for ongoing use by the staff members for arc flash and safety program management and tracking.
  8. Arc flash hazard labeling.
  9. Assistance with the development of Energized Work Permits.
  10. Arc flash and electrical safety training.
  11. Personal Protective Equipment (PPE) training.
- B. An electrical arc flash hazard analysis shall be performed to determine incident energy, arc flash protection boundaries, and required PPE for all electrical equipment in the facility. The calculations shall comply with NFPA-70E 2004, and IEEE-1584-2002. An integral part of NFPA-70E compliance is integrating work permits with arc flash assessment for all equipment in this facility. This section describes in detail the requirements for the study as well as integrating work permits in the system model for 70E compliance.
- C. The purpose of this study is to provide a comprehensive software model of the electrical distribution system, which will document facility compliance with NFPA 70E mandates as described below. This model will serve as an integral part of an ongoing safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E 2004 Article 130.1(A)(2) for each electrical equipment in the facility.
1. Article 205.3, 120.2(F)(1): Updated and verified one-line diagram for all electrical distribution voltages including all sources for lock-out and tag out procedures.
  2. Article 400.5, 400.6: Updated short circuit and equipment duty verification study showing all electrical equipment is properly rated to withstand and interrupt the available short circuit duty per ANSI Standards and NEMA/UL/NEC requirements.
  3. Article 400.6, 410.9: Updated protective device coordination study showing the system protective devices are properly set to coordinate and clear a fault without extensive equipment damage or personnel risk.
  4. Article 130.3(A)(B), 110.8: Updated arc flash study providing maximum incident energies, arc flash boundaries, and PPE requirements for each equipment in the system. In addition, these calculations shall be integrated with 70E compliant work permits as part of an ongoing safety program.
  5. Article 130.16(E), 400.11, 400.14, 400.21(C)(2), 410.8: Updated labeling displaying the worst-case arc hazard values for each equipment in the facility.
- D. The analysis shall consist of the following:
1. Field data collection by qualified personnel (as defined by NFPA 70E).
  2. Data entry and system one-line modeling in commercially available power system software.
  3. Model verification.
  4. Short Circuit and equipment verification study.
  5. Protective device coordination study.
  6. Arc flash hazard study.
  7. Detailed report and findings of the analysis.
  8. Electronic copies of the Project Report and the System Modeling File.
- E. The analysis and procedures shall comply with the following standards and recommended practices for power system studies.
1. NFPA-70E, 2004 Standard for Electrical Safety in the Workplace
  2. IEEE-1584-2002
  3. IEEE-242 "Buff Book" Protection and Coordination of Industrial Power Systems
  4. IEEE-399 "Brown Book" Power System Analysis

## 5. IEEE-141 “Red Book” Electric Power Distribution for Industrial Plants

### 2.3 DATA COLLECTION

- A. Field data collection shall be performed by qualified individuals (as defined by NFPA 70E – 2004) to ensure accurate equipment modeling.
- B. Field data collection and system modeling shall be based on the system installed.
- C. Equipment shall be visually inspected to collect the necessary nameplate data used in the analysis, including transformers, switchgear and breakers, relays, direct-acting trip units, etc. Data that may not be readily accessible or may not have nameplate data such as conductors, busway, etc. can be taken from drawings.
- D. Data collection shall include the step down transformer from the utility service (including primary relaying) down through each 480-volt motor control center (MCC) and 240/208 volt panels for all systems served by transformers rated greater than 125 kVA as per IEEE-1584-2002.
- E. The CONTRACTOR shall obtain from the utility the minimum, normal, and maximum operating service voltage levels, three-phase short circuit MVA and X/R ratio, as well as line-to-ground short circuit MVA and X/R ratio at the point of connection as shown on the drawings.

### 2.4 SYSTEM MODELING

- A. The system model shall be developed using a commercially available, fully integrated software package that meets the performance specifications developed in this Section. To ensure compliance with NFPA-70E 2004, ANSI, and IEEE Standards, and OSHA mandates, no exceptions or substitutions to the performance specification are allowed.
- B. The system model shall be laid out in one drawing/view and in a manner that provides for easy viewing of all analysis results. The one drawing/view requirement ensures that problem areas found and highlighted by the program are easily seen and not hidden or buried in multiple drawings, eliminating potential human errors where multiple drawing verification is required.
- C. All one-line symbols shall be spaced properly to facilitate viewing results on the one-line.
- D. Equipment names used in the modeling software shall be identical to the equipment and naming convention shown on the drawings and equipment unless conflicts exist. The CONTRACTOR shall bring all naming convention conflicts or deficiencies to the attention of the ENGINEER for clarification.
- E. The facility may have multiple operating conditions, including, but not limited to, generation on/off, shutdown, bus-ties, start-up, emergency operation, etc. Each of the operating modes shall be documented and modeled in the software in order to determine the worst-case arc flash hazard and associated parameters for the electrical equipment. For the purpose, assume that up to four (4) operating modes are possible.

- F. The software shall model each operating mode in a manner such that each mode is a scenario or change case from the base case. Each scenario shall be a simple differential algorithm storing only the difference from the base case and the scenario. Modifications to the base case model shall automatically update all scenarios to eliminate the necessity to store complete databases for each condition, providing for a manageable file size that can be Emailed and eliminating the associated time, man hours, and errors with updating each database individually.
- G. Project files created by the software shall be single files and not project directories containing multiple files. The file shall be self-contained and have all necessary information to describe the one-line, system data, settings, and analysis information. Files shall be easily transferable to any site via Email or disk and operable with no setting changes to the database file to eliminate the maintenance and administrative problems associated with multi-file project directories, and to provide an easy method to transfer the file for engineering review.
- H. The software shall accurately model daisy-chained MCC's, panels, and sub-transformers without the use of intermediate buses, nodes or fake impedances.
- I. Lumped motor groups for MCC's shall be modeled per IEEE standards using groups >50 Hp, and <50 Hp. Where motor list data is not available, single lumped groups may be modeled per IEEE-141 "Red Book".
- J. Medium voltage motors greater than 1.0 kV shall be modeled individually on their respective buses including all protective phase and ground overcurrent relays and fuses. This model will provide individual work permits for each starter/motor on the one-line.
- K. All low voltage power circuit breaker (LVPCB), insulated case (ICCB), molded case (MCCB) and fuse data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
- L. All relay data shall be modeled based on the actual nameplate data including manufacturer, type, style, trip device, and actual settings. Generic substitutions or assumptions shall not be allowed unless data cannot be field verified. All assumptions shall be documented in the report.
- M. All overcurrent relay types for the distribution system shall be modeled on the one-line diagram (and database) including phase and ground overcurrent, differential, residual, ground neutral, etc. to establish a complete and detailed system model where protective device data can be easily modified and updated by the facility and all data is available for a comprehensive protective device coordination study if required in the future.
- N. Relay models shall depict the actual connection requirements. See Figure-1.3M. Programs using symbols as shown in Figure-1.3M(na) are not acceptable since they do not depict the actual system and can lead to confusion in determining arc flash results and proper protective device modeling.
- O. Multi-function relays shall have all their overcurrent devices modeled in a single device and shall be able to accept multiple CT's.



- P. All equipment modeling must have a corresponding one-line diagram symbol. This means that there can be no hidden database models. The purpose is for the facility to easily see all equipment, its associated data, to be able to link documents to the equipment as a data repository, etc. and to see problems right on the one-line.
- Q. All system modeling shall conform to accepted modeling practices as outlined in IEEE-399 "Brown Book". Contractor/consultant may provide more advanced modeling techniques where compliance with the specification is maintained.

## 2.5 MODEL VERIFICATION

- A. The system model shall be verified by reviewing the results of short circuit current flows for all buses/equipment in the system. The results shall be viewed on each branch and total flow into a bus/equipment on the system one-line diagram. The purpose is to visually spot check values with recognized industry benchmarks as to the expected amount of short circuit current, and correct any problem areas.

## 2.6 SHORT CIRCUIT STUDY

- A. A short circuit study shall be performed to verify all equipment duties in the system. The calculations shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The short circuit study shall verify the system electrical equipment is properly rated to withstand and interrupt the expected bolted and arcing faults in the system. Improperly rated and applied equipment may not protect personnel against arc flash hazards even if properly applied PPE is used. The software program must comply with the above standards in order to properly verify equipment installed in North America. No substitutions will be allowed.
- B. The equipment duty verification shall determine both the line side and load side fault current through each equipment and use the highest current to verify equipment ratings. Standard bus faults are not acceptable for protective devices in that they do not accurately model the current through the device and consequently they provide erroneous results. For solidly grounded systems, both three-phase and single-line-to-ground faults should be modeled. For other grounding configurations only a three-phase fault is required.
- C. Equipment duty results shall be graphically displayed on the electrical one-line as well as tabular report format.
- D. The results of the equipment duty verification tabular format report shall provide the following data:
  - 1. Equipment name and kV
  - 2. Manufacture, type, style, and ratings of the device
  - 3. Actual line or load side currents through the device and percent over/under duty
  - 4. Flag for the device showing VIOLATION or WARNING level for visual identification
- E. A report of all problem areas shall be provided. Contractor shall notify Horrocks Corporation – Northwest Quadrant Facility personnel immediately of all problems found in this system before proceeding in the study. A recommended action list shall be provided for all underrated equipment in the system.

## 2.7 PROTECTIVE DEVICE COORDINATION (PDC) STUDY

- A. A PDC study shall be performed in order to determine if the system protection characteristics are sufficient to provide reliable power to the facility. The PDC study will also determine if the settings entered in the software will provide proper personnel protection in the arc flash portion of this study. For facilities where the main distribution is low voltage (under 600 volts) and only instantaneous breakers or fuses are used, this section may not apply.
- B. The PDC study shall consist of system feeders and branch circuits 100amps and larger, and plotting the time-current curves (TCC's) to verify proper selective operation of the protective devices. The study should also determine if the settings can be enhanced to provide increased personnel/equipment protection without sacrificing selective coordination.
- C. The CONTRACTOR shall notify the ENGINEER of any potential problems in the protective device settings that affect either selective operation and reliability or personnel protection and shall provide recommendations for changes in writing before continuing with the study.
- D. As specified in the data collection and modeling sections, all PDC data shall be modeled on the one-line diagram and in the equipment database.
- E. The CONTRACTOR shall contact the serving utility and obtain protective device settings for all service entrance over current devices in series with the facility and affecting coordination with facilities distribution system.
- F. TCC Specifics: The TCC's shall graphically illustrate on log-log paper that adequate time separation exists between series devices. The specific time - current characteristics of each protective device shall be plotted in such a manner that sufficient upstream devices will be clearly depicted on one sheet to prove selective coordination.
  - 1. TCC's shall include a system one-line diagram and protective device coordination curves for each device in the selected area. The TCC shall be printed in color on 8 ½ x 11" paper – full size portrait mode, using a log-log scale. The one-line diagram shall be part of the TCC and include all protective devices, equipment names, and short circuit currents calculated from the main one-line. The purpose of this requirement is to provide all necessary information on one sheet, in a format easily readable and standard to the industry.
  - 2. For low voltage systems, TCC's shall be developed for both phase and ground protective devices. One phase and one ground TCC should be developed for each unit substation. The TCC should show the largest feeder/motor protective device in the MCC or panel up through the switchgear/switchboard feeder breaker, transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker. For secondary switchboards serving large loads or a wide variety of loads that may affect upstream coordination, additional TCC's may be required.
  - 3. For medium voltage systems, TCC's shall be developed for both phase and ground protective devices. The TCC should show the largest feeder/motor protective device in the lineup up through the switchgear/transformer secondary main, unit substation primary fuse, and medium voltage feeder breaker.
  - 4. The following specific information shall also be shown on the coordination curves:
    - a. Device identification.
    - b. Voltage and current ratio for curves.
    - c. Transformer three - phase and single-line-to-ground ANSI damage curves.

- d. Transformer inrush points.
  - e. Minimum melting, and clearing curves for fuses, and if available the no-damage curve.
  - f. Cable damage curves.
  - g. Motor starting locked rotor curves, and if available the motor locked rotor damage point.
  - h. Maximum short circuit cut-off point.
  - i. Clearly marked short circuit current levels through each protective device/branch, which should be based on the appropriate current through the device, i.e. Momentary, Interrupting or 30 Cycle current.
  - j. Protective device one-line diagram clearly showing all protective devices on the time-current curve, labels for each device, open breakers, faulted buses, and the short circuit current flowing in each branch.
  - k. Each TCC sheet shall have appropriate identification and a one-line diagram that applies to the specific portion of the system associated with time-current curves on that sheet.
  - l. Each protective device curve shall be terminated at a point reflecting maximum symmetrical or asymmetrical fault current through the device.
  - m. Identify the device associated with each curve by manufacturer type, function, and setting – i.e. tap, time delay, and instantaneous, pickup, etc.
  - n. Primary Protective Device Settings for Delta-Wye Connected Transformer:
    - 1) Secondary Line-To-Ground Fault Protection: Provide primary protective device operating band within the transformer's characteristics curve, including a point equal to 58 percent of ANSI C57.12.00 withstand point.
    - 2) Secondary Line-To-Line Faults: Provide 16 percent current margin between primary protective device and associated secondary device characteristic curves.
  - o. Typical time separations for curves:
    - 1) Contractor shall discuss the advantages and disadvantages of various time separation settings between device curves with Horrocks Corporation – Northwest Quadrant Facility personnel to help determine how the system settings shall be optimized for selectivity and arc flash hazard reduction.
- G. A setting table shall be developed to summarize the settings selected/existing for the protective devices. The table shall include the following:
- 1. Device identification.
  - 2. For low voltage breakers, the circuit breaker manufacturer, type, and style, sensor rating, long-time, short-time, instantaneous settings, and time bands. For breakers with ground fault capability, the pickup and time delay.
  - 3. Fuse manufacturer, type, style, and rating.
  - 4. Protective relay manufacturer, type, style, function (51, 50, 67, etc.) pickup, current multiplier, time dial, and delay. For multi-function units, list all devices being used. Include the CT and/or PT ratios for each function.
- H. The software shall provide complete integration of the one-line, database, short circuit, protective device coordination and arc flash analysis functions to provide accurate calculations and avoid errors and inefficiencies associated with multiple data entry programs. Programs using separate PDC or TCC plotting packages are not allowed. Complete PDC integration is defined as the following:

1. TCC's shall be developed by simply selecting (highlighting) with the mouse the one-line area to be coordinated. The TCC shall automatically be plotted for the selected area including all short circuit levels. The TCC plot shall automatically include the selected one-line area in a drag and drop window on the TCC showing all one-line attributes without user additions required. These attributes shall automatically include all short circuit currents and voltages displayed on the main one-line, equipment names, etc. and update automatically without additional user input.
2. Programs requiring the user to build a separate TCC one-line are not integral with system short circuit calculations and do not automatically update as the system one-line changes, requiring additional man-hours for one-line development and are consequently prone to errors as the system changes. These types of programs shall not be considered for the study.
3. Each TCC shall have momentary (1/2 cycle), interrupting (1-4 cycle), and 30 cycle short circuit currents (tick marks) displayed on the TCC plot for each protective device or as required to properly model the tripping characteristics of the device. The tick marks shall be user adjustable for visual appearance. The purpose is to provide accurate tripping currents for each device.
4. The software model shall allow each protective device to model momentary (1/2 cycle), interrupting (1-4 cycle), and 30 cycle short circuit currents simultaneously depending on the characteristics of the device.
5. The software shall model remote voltages and currents for any single fault and display them on the TCC showing all trip cutoffs based on the remote currents. The purpose is to accurately model and verify backup relaying to ensure selective operation under all fault conditions. PDC programs that perform only batch faults, or fail to model remote voltages and currents for all fault types shall not be considered.
6. The software shall model and display time difference calculations for any selected pair of protective devices. The difference calculator shall include bracketing bars with the calculated difference to clearly show the selective time between the devices. The calculated time shall update dynamically for instant visual setting as the devices are dragged (settings modified). In addition, tool tips shall clearly show the time difference and the protective device settings for all devices as they are dynamically changed or set to allow the user to accurately determine the proper setting between devices in the most efficient manner, reducing coordination time and providing more accurate results.
7. The software model shall provide for WYSIWYG drag and drop modeling of all protective devices and provide for tool tips and notes to display all settings dynamically. The purpose is to provide accurate adjustments and settings in the most time efficient and accurate manner.
8. TCC's shall have the ability to display short circuit currents and arc flash hazard results within the fully integrated system one-line in the PDC focus. Short circuit currents are available at any equipment with a single mouse click. Short circuit currents and arc flash hazard values shall change on the fly as the protective device settings change, allowing the user to instantly see the results of PDC changes and the associated impact to short circuit currents and arc flash hazard values.
9. The software model shall provide a detailed library for the most common protective devices available in North America. The library shall be user definable.

## 2.8 ARC FLASH STUDY

- A. A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical system studied. The calculations shall comply with NFPA-70E 2004, and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA-70E and to facilitate a safety program for the OWNER, and to provide a comprehensive software model of the electrical distribution system, which provides integral work permits and arc flash calculations in compliance with NFPA 70E Article 130.1(A)(2) for all equipment in the facility. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.
- B. The arc flash study shall determine the following results for each system mode of operation. The results shall be provided in spreadsheet format for each mode and electrical system location to provide easy viewing and comparison. Worst-case arc flash energy levels shall be flagged and the spreadsheet comparison table shall be capable of providing its output directly to high quality vinyl label printers. The calculations shall, as a minimum, include a comparison of both 100% and 85% arcing currents for low voltage equipment for each electrical system configuration or operating mode, indicating worst-case arc flash hazards. The spreadsheet results shall include:
1. Equipment name and voltage.
  2. Upstream equipment device name and ANSI function, i.e. 51/50, etc.
  3. Equipment type, i.e. switchgear, MCC, Panel, VFD, etc.
  4. Equipment arc gap.
  5. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
  6. Trip time, opening time, and total clearing time (total Arc time) of the protective device.
  7. Worst-case arc flash boundary for each bus/equipment in the model.
  8. Worst-case arc flash hazard incident energy in cal/cm<sup>2</sup> for each bus/equipment in the model.
  9. Worst-case personal protective equipment (PPE) for each bus/equipment in the model.
  10. Working distances for up to five different distances showing items 7, 8, and 9 for each distance.
  11. Indicate "Danger/Hazardous" areas where incident energy is greater than 40 cal/cm<sup>2</sup> and provide recommendations to reduced arc flash energy levels for these areas.
  12. Flag results where 85% arcing current provided worst-case results.
- C. Each mode of operation shall include a detailed write-up indicating areas where incident energy calculations and PPE requirements are higher than calculated in the normal operating mode.
- D. Consultant/contractor shall provide a detailed arc flash analysis report including as a minimum:
1. Introduction.
  2. Methodology.
  3. Information Sources.

4. Key Assumptions.
  5. Arc Flash Energy and other consideration for various System Modes of Operation (maintenance mode, bus-tie, co-gen on/off, etc.).
  6. Arc Energy at 100% and reduced currents.
  7. IEEE 1584-2002 Considerations.
  8. Overcurrent Protective Device Changes, Replacements or Setting Changes implemented in study to reduce arc flash hazard exposure.
  9. Explanation of Data in Arc Flash Hazard Report Tables.
  10. NFPA 70E Information.
    - a. Shock Hazards with covers removed.
    - b. Shock Hazard Approach Boundaries.
      - 1) Limited Approach Boundary.
      - 2) Restricted Approach Boundary.
      - 3) Prohibited Approach Boundary.
    - c. Arc Flash Hazard Boundaries.
  11. Results of Arc flash Hazard Analysis for high voltage, medium voltage and low voltage systems, including:
    - a. Working distances.
    - b. Energy Levels.
    - c. PPE Requirements.
    - d. Recommendations to reduce arc flash hazard energy and exposure.
  12. Arc Flash Hazard Report.
    - a. 5 Hard Copies.
    - b. 1 Electronic Copy in Adobe Acrobat format (5.0 or later).
  13. Electronic file for Power System Modeling Software as developed and utilized for this analysis.
- E. The CONTRACTOR shall provide printed labels for labels for all equipment in the system from the project study file. Assume three (3) labels per equipment/bus in your estimate using 4" x 6" labels or one (1) 6" x 8" label per equipment bus. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z535. The labels shall be printable directly from the power system software utilized for the study with a Duralabel, Brady PowerMark or GlobalMark printer to ensure that the OWNER's personnel have the option of printing the labels without the extra expense of going to an outside printing service, converting arc flash results to spreadsheet format or performing tedious manual data entry.
- F. Software Requirements: The software shall provide complete integration of the one-line, database, short circuit, PDC and Arc flash functions. Software using separate short circuit, PDC, TCC or arc flash programs is not allowed. Spreadsheet calculations are not allowed. The purpose of this section is to ensure that the arc flash hazard calculations comply with NFPA-70E and IEEE-1584, and that the calculations are programmed with necessary requirements to help eliminate possible errors in the arc flash calculations. The additional purpose is to establish a detailed software model of the XYZ Corporation – Abc Facility electrical distribution system, which will document compliance with the OSHA requirements and NFPA 70E mandates. This model will serve as an integral part of the OWNER's safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E Article 130.1(A)(2) for each electrical equipment in the facility.

1. Arc flash calculations shall be performed with enhanced IEEE-1584 equations, which eliminate voltage discontinuities and the non-conservative/average results of the standard equations. The purpose of this requirement is to ensure that the calculated incident energies are closer to actual test results insuring a conservative calculation minimizing personnel risk.
2. Arc flash calculations shall be based on the fastest clearing upstream protective device protecting the equipment for single sources and the slowest upstream protective device for multiple sources. The calculations shall automatically compare all series and parallel upstream protective devices in the system to determine the fastest series device or a conservative parallel clearing time. The algorithm shall incorporate a traversing routine that can search back an unlimited number of buses/nodes and consider all series and parallel branches in the comparison to ensure accurate answers and to prevent hazards associated with incorrect results. Software shall not have trace back limits (5-10 buses) that can provide incorrect answers for low voltage faults that require high voltage protective device clearing to prevent potential errors.
3. The arc flash calculations including arc flash boundary, incident energy, PPE requirements, and working distance shall be displayed on the software one-line diagram and TCC simultaneously. The software must show visually the arc flash values as the settings are incrementally changed (dragging curves) so the protection can be optimized in the most efficient manner, allowing the protection engineer to visually balance the competing objectives of personnel protection with that of system selectivity.
4. The arc flash calculations shall include four (4) calculation options to ensure that the software provides the flexibility required to meet any system configuration or training requirement that may be considered. Each calculation option shall comply with the graphic and spreadsheet display requirements of this section. Each option is more specifically described below.
  - a. The detailed option shall provide the let-through energy for each protective device in the system. This is the energy on the load side of the protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
  - b. Worst-case including main protective device. This option shall provide the worst-case arc-hazard energy for the equipment based on the let-through energy of the equipment's main protective device. If the equipment is not equipped with a main device, the program must traverse back the entire system to determine the fastest series upstream protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
  - c. Worst-case excluding main protective device. This option shall provide the worst-case arc-hazard energy for the equipment based on the let-through energy of the fastest upstream series protective device in the system. The program shall traverse back the entire system to determine the fastest upstream protective device. The equipment shall be highlighted when the let-through energy exceeds a user defined threshold-clothing limit.
  - d. Worst-case excluding and including the main protective device. A combination of options 'b' and 'c' as stated above.

5. The arc flash calculations shall provide integral “Work Tasks” for the listed equipment types. The tasks shall be derived from 70E Table 130.7(C)(9)(a) and be specific to the equipment type. Work tasks shall be user definable in the software to allow customization and integral with the “Work Permit” feature of the software. Listed equipment types shall include:
  - a. Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 100-200 volt equipment.
  - b. Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 200-1000 volt equipment.
  - c. Switchgear, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 1.0-5.0 kV equipment.
  - d. Switchgear, MCC, VFD, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 5.0-15.0 kV equipment.
  - e. Switchgear, Interrupting Switch, Conductor, Open Air for 15.0-38.0 kV equipment.
  - f. Interrupting Switch, Conductor, and Open Air for 38.0-1500 kV equipment.
6. Work Tasks shall have a user-defined library that provides the following customizable features for each work task:
  - a. Work Tasks for each specific equipment type and voltage range.
  - b. Working distance units English or Metric.
  - c. Work distance for each task.
  - d. V-rated gloves and tool requirements.
  - e. Job description and procedures.
  - f. Safe work practices description.
  - g. Hazard Risk Category (HRC) reduction. \*Note: HRC reduction can only be used based on a documented risk assessment as an integral part of a safety program.
7. Work tasks shall be accessible from the one-line diagram for any equipment through a mouse click on the equipment in the electrical system model one-line. A dialog box shall appear listing all 70E and user definable work tasks for the specific equipment selected. The work task dialog shall include a user definable working distance for each work task and allow the user to select tasks specific to any equipment feeder or the incoming main. Work tasks for each equipment type shall be voltage specific and user definable in the library. The purpose of these requirements is to integrate 70E work tasks to the one-line diagram for specific equipment types. This will provide the basis for a customized safety program and work permit process compliant with 70E mandates. The level of detailed requirements for the “work task” software is necessary to ensure that any variation of equipment type, equipment layout, or work procedure can be handled and documented in the software.
  - a. The software interface shall allow the user to select any breaker fuse or switch on the one-line, and get a specific work task generated for that device showing the load side arc flash hazard (let-through energy) for that device. The purpose of this requirement is to detail specific feeder hazards when work tasks dictate working downstream from a feeder protective device.
  - b. The arc flash calculations shall provide integral work permits for compliance with NFPA-70E, 2004 Article 130.1 (A). The work permits shall be integral with the system one-line diagram and the arc flash calculations and shall detect and account for work between feeder and main breaker.



8. Work permits shall be activated by mouse click, for all equipment types listed in K5. Work permits shall have the following calculated values and provide the following information specific to the “work task” and equipment selected:
  - a. Shock hazard.
  - b. Shock hazard boundaries.
  - c. Arc flash boundary – worst-case for each equipment.
  - d. Arc flash hazard incident energy in cal/cm<sup>2</sup> for the equipment.
  - e. Hazard Risk Category (HRC) and any applicable risk reduction.
  - f. Required PPE category based on calculated energy level and optional risk reduction.
  - g. Required PPE description based on PPE category.
  - h. Determination of V-rated gloves and tools.
  - i. Auto fill job description and procedures for each work task.
  - j. Auto fill safe work practices description for each work task.
  - k. Job briefing and planning check list.
  - l. Approval sign off section.
  - m. Working distance measurements in English or Metric units.
  - n. Required work distance for each task.
  - o. Documentation for safety program in compliance with 70E 130.1(A).
9. The work permits shall be created by the software in MS Word and have the following user customizable features:
  - a. Work Tasks for each specific equipment type and voltage range.
  - b. Restricted shock boundary.
  - c. Arc flash boundary – worst-case for each equipment.
  - d. Arc flash hazard incident energy in cal/cm<sup>2</sup> for the equipment.
  - e. Hazard Risk Category (HRC) reduction for low risk tasks.
  - f. Required PPE category based on risk reduction.
  - g. Working distance in English or Metric units.
  - h. Working distance for each task.
  - i. V-rated gloves and tool requirements.
  - j. Flame Resistant clothing requirements.
  - k. Job description and procedures for each work task.
  - l. Safe work practices description for each work task.
  - m. Job briefing and planning check list.
  - n. Approval sign off section.
10. The power system software shall allow the created work permits to be linked via Windows “hyperlinks” to each equipment on the one-line diagram. The purpose is to provide a data repository of work permits performed on each equipment for 70E review, as well as providing a one-stop location where documents pertaining to the equipment can be accessed by maintenance and job planning.
11. The power system software shall be fully compatible with facility arc flash hazard and electrical safety implementation software that provides the following capabilities:
  - a. Calculates shock hazards, shock hazard boundaries, arc flash boundaries, incident energies, PPE requirements, etc. for power systems modeled in EasyPower or EasyPower EasySolv.

- b. Built in Work Permit Feature for creation of custom Energized Work Permits complying with the NFPA-70E requirements. Work permit feature shall include NFPA risk assessment categories based on the task performed for all types of electrical equipment and voltage ranges. The work permit feature shall include an extensive library of user definable work tasks, safety procedures and safe work practices, saving XYZ Corporation – Abc Facility plant engineering staff, maintenance staff and contractors hours of productive time.
  - c. Energized work permits, safety procedures, equipment instruction manuals, etc., shall be capable of being directly linked to the equipment one-line through a Hyperlinks feature, providing a one-stop data repository easily accessible to all plant and safety personnel, saving plant personnel and contractors significant productive time in locating the right instruction manual, equipment safety procedure, drawing, pictures and maps for the equipment. This feature shall also help XYZ Corporation – Abc Facility comply with OSHA and NFPA 70E record keeping requirements.
  - d. Additional equipment information and records such as Maintenance Records, Maintenance Manuals, Operations Manuals, Lock out / Tag out procedures, etc. shall also be capable of being Hyperlinked to the equipment on the graphical one-line.
  - e. Program shall support creation of arc flash labels with direct output to high quality UV resistant vinyl label printers.
  - f. Program shall also have customizable output. Includes one-line printing, text report creation, export to AutoCAD, etc.
  - g. Program shall be a Windows based operating system and shall use Windows conventions.
  - h. Program shall be capable of being installed on stand alone personal computers or on networked systems.
  - i. Program shall be easily operable by the OWNER's staff without any specialized training.
12. The software shall be licensed to the OWNER and the original software package will be delivered at project completion.

## 2.9 REPORTING AND ANALYSIS SUMMARY

- A. Executive Summary: The executive summary shall be brief 1-2 pages maximum and cover at an executive level the findings of the study, recommendations, and requirements for maintaining NFPA-70E compliance.
- B. Scope of studies performed: The scope shall provide details of what actions were intended to be performed for each aspect of the study, including short circuit, protective device coordination, and arc flash.
- C. Description of system and explanation of bus and branch numbering system.
- D. Modes of operation studied: Each scenario/plant operating condition shall be thoroughly documented.
- E. Detailed report and results of short circuit, coordination, and arc flash studies including:
  - 1. Recommendations and additions to equipment rating and/or PDC characteristics.
  - 2. Recommendations to reduce arc flash hazards for equipment with incident energies over 40 cal/cm<sup>2</sup>.
- F. Prioritized recommendations for all studies.
- G. Action list and check off column for all recommendations.

## 2.10 QUALITY ASSURANCE

- A. The studies shall be in conformance with the NFPA and ANSI Standards, and IEEE recommended practices detailed in this section. No substitutions in study methods or software conformance will be allowed.

**END OF SECTION**

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**SECTION 26 05 08**  
**ELECTRICAL ACCEPTANCE TEST**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

- A. This section covers the work necessary to provide the inspection and testing services required to place the electrical system into operation.

**1.2 GENERAL**

- A. This work may be conducted by the electrical subcontractors and/or independent testing laboratory but shall be performed by qualified personnel. The term "testing laboratory" shall unilaterally refer to the firm, subcontractor, etc., approved to conduct the tests.
  - 1. For the purposes of the section the individual performing the testing, whether the electrical subcontractor, manufacturer's representatives or independent testing laboratory, shall be referred to as "testing laboratory."
  - 2. The Contractor shall submit a division of responsibilities that shall detail who is responsible for performing each test.
  - 3. All visual and mechanical inspections shall be conducted by the Contractor and Engineer.
- B. The testing laboratory shall provide all material, equipment power, labor and technical supervision to perform such tests and inspections.
- C. It is the intent of these tests to assure that all electrical equipment is operational within industry and manufacturer's tolerances.
- D. Upon completion of the tests and inspections noted in these specifications, a label shall be attached to all serviced devices. These labels will indicate date serviced and the service company responsible.
- E. The tests and inspections shall determine suitability for continued reliable operation.
- F. All tests shall be conducted in the presence of the Engineer.
- G. Electrical testing specified herein, and functional testing of all power and controls not tested under the Section 40 10 00 Process Control and Instrumentation Systems, shall be completed before commencement of the 7-day test specified in Section 26 05 08, Electrical Acceptance Tests.
- H. The work may require the Contractor to activate circuits, shutdown circuits and run equipment, make electrical measurements, replace blown fuses, install temporary jumpers, etc.
- I. Specific scope of work:
  - 1. The following items of equipment shall be tested:
    - a. Low voltage switchgear
    - b. Motor control centers
    - c. Transformers
    - d. All wires and cables
    - e. Motors
    - f. Grounding system

- g. Entire control system and all process interfaces
- h. Adjustable speed drive (ASD) systems
- i. Switches
- j. Lighting
- 2. All inspections and tests shall utilize the following references:
  - a. Project design specifications
  - b. Project design drawings
  - c. Manufacturer's instruction manuals applicable to each particular apparatus.
- J. Division of responsibility:
  - 1. The Contractor shall perform routing insulation resistance, continuity and rotation tests for all distribution and utilization equipment prior and in addition to tests performed by the testing laboratory specified herein.
  - 2. The Contractor shall supply a suitable and stable source of test power to the test laboratory at each test site. The testing laboratory shall specify requirements.
  - 3. The Contractor shall notify the testing laboratory and schedule with the Engineer when equipment becomes available for acceptance tests.
  - 4. The Contractor shall notify the Engineer prior to commencement of any testing.
  - 5. The testing laboratory shall be responsible for implementing all final settings and adjustments on protective devices and tap changes in accordance with Owner's specified values.
  - 6. Any system material or workmanship which is found defective on the basis of acceptance tests shall be reported directly to the Engineer.
  - 7. The testing laboratory shall maintain a written record of all tests and upon completion of project, assemble and certify a final test report.

### 1.3 REFERENCED STANDARDS

- A. See Section 26 05 00, General Electrical Requirements, which lists the standards that apply to the work specified herein.
- B. In addition, the following shall apply:
  - 1. Manufacturer's recommended tests
  - 2. ANSI C2, C37.20.1
  - 3. NEMA WC 7, WC 8
  - 4. IEEE 43,48,81,118
  - 5. NETA ATS
  - 6. NFPA 70

### 1.4 SUBMITTALS DURING CONSTRUCTION

- A. Submittals during construction shall be made in accordance with Division 1, GENERAL REQUIREMENTS and Section 26 05 00, General Electrical Requirements.
- B. In addition, the following information shall be provided:
  - 1. Shop drawings:
    - a. The testing laboratory shall submit a complete resume and statement of qualifications detailing their experiences in performing the test specified. This statement shall include:
      - 1) Corporate history and references.

- 2) Resume of individual performing test.
  - 3) Equipment list and test calibration data.
- b. The Contractor shall submit to the Engineer and the testing laboratory, Contractor Submittals, complete manufacturer's field testing acceptance testing procedures, as well as expected test results and tolerances for all equipment to be tested.
- 1) Administrative Submittals: Submit 30 days prior to performing inspection or tests:
  - 2) Schedule for performing inspection and tests.
  - 3) List of references to be used for each test.
  - 4) Sample copy of equipment and materials inspection form(s).
  - 5) Sample copy of individual device test form.
  - 6) Sample copy of individual system test form.
  - 7) Quality Control Submittals: Submit within 15 days after completion of test: Test or inspection reports and certificates for each electrical item tested.
  - 8) Contract Closeout Submittals:
    - a) Operation and Maintenance Data:
    - b) In accordance with Section 26 05 00, Operation and Maintenance Data
    - c) After test or inspection reports have been reviewed by Engineer and returned, insert a copy of each in Operation and Maintenance Manual.
2. Test Report:
- a. The test report shall include the following:
- 1) Summary of project.
  - 2) Description of equipment tested.
  - 3) Description of test.
  - 4) Test results.
  - 5) Conclusions and recommendations.
  - 6) Appendix, including appropriate test forms.
  - 7) List of test equipment used and calibration date.
- b. Furnish six (6) copies of the completed report to the Engineer.

## **PART 2 - PRODUCTS**

### **2.1 TEST INSTRUMENT TRACEABILITY**

- A. The testing laboratory shall have a calibration program which maintains all applicable test instrumentation within rated accuracy.
- B. The accuracy shall be traceable to the National Bureau of Standards in an unbroken chain.
- C. Instruments shall be calibrated in accordance with the following frequency schedule.
1. Field instruments - 6 months maximum.
  2. Laboratory instruments - 12 months.
  3. Leased specialty equipment - 12 months. (Where accuracy is guaranteed by lessor).
- D. Dated calibration labels shall be visible on all test equipment.

- E. Records must be kept up-to-date which show date and results of all instruments calibrated or tested.
- F. An up-to-date instrument calibration instruction and procedure will be maintained for each test instrument.

## **PART 3 - EXECUTION**

### **3.1 SAFETY**

#### **A. Safety and Precautions:**

##### **1. Safety practices shall include, but are not limited to the following requirements:**

- a. Occupational Safety and Health Act - OSHA
- b. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
- c. Applicable State and Local safety operating procedures.
- d. NETA Safety/Accident Prevention Program.
- e. National Fire Protection Association - NFPA 70E.

##### **2. The testing laboratory shall be solely responsible for safety during all tests.**

##### **3. In all cases, work shall not proceed until the testing laboratory, Contractor, and Engineer determine that it is safe to do so.**

##### **4. The testing laboratory shall have available sufficient protective barriers and warning signs to conduct specified tests safely.**

#### **B. Testing requirements prior to commencing the work:**

- 1. All instruments required must be available and in proper operating conditions.
- 2. All dispensable materials such as solvents, rags and brushes required must be provided.
- 3. All equipment handling devices such as cranes, vehicles, chain falls and other lifting equipment must be available or scheduled.
- 4. All instruction books, calibration curves or other printed material to cover the electrical devices must be available.
- 5. Data sheets to record all test results must be available before the work is started.

#### **C. Tests and inspection shall establish that:**

- 1. Electrical equipment is operational within industry and manufacturer's tolerances.
- 2. Installation operates properly.
- 3. Equipment is suitable to be energized.
- 4. Installation conforms to requirements of these specifications and NFPA 70, NFPA 70E, and ANSI C2.

#### **D. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.**

#### **E. Adjust all mechanisms and moving parts for free mechanical movement.**

#### **F. Adjust all adjustable relays and sensors to correspond to operating conditions, or as recommended by manufacturer.**

#### **G. Verify nameplate data for conformance with these specifications.**

#### **H. Realign equipment not properly aligned and correct any unevenness.**

#### **I. Properly anchor electrical equipment found to be inadequately anchored.**



- J. Tighten all accessible bolted connections, including wiring connections, with calibrated torque wrench to manufacturer's recommendations, or otherwise specified.
- K. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.
- L. Provide proper lubrication of all applicable moving parts.
- M. Inform Engineer of any working clearances not in accordance with NFPA 70.
- N. Investigate and repair or replace:
  - 1. Electrical items that fail tests.
  - 2. Active components not operating in accordance with manufacturer's instructions.
  - 3. Damaged electrical equipment.
- O. Electrical enclosures:
  - 1. Remove foreign material and moisture from enclosure interior.
  - 2. Vacuum and wipe clean enclosure interior.
  - 3. Remove corrosion found on metal surfaces.
  - 4. Repair or replace, as determined by the Engineer, door and/or panel sections having dented surfaces.
  - 5. Repair or replace, as determined by the Engineer, poor-fitting doors and/or panel sections.
  - 6. Repair or replace improperly operating latching, locking, or interlocking devices.
  - 7. Replace missing or damaged hardware.
  - 8. Finish:
    - a. Provide matching paint and touch-up scratches and mars.
    - b. If required due to extensive damage, as determined by the Engineer, refinish the entire assembly.
- P. Replace fuses and circuit breakers that do not conform to size and type required by these specifications.
- Q. Replace transformer insulating oil not in compliance with ASTM D923.

### 3.2 QUALITY ASSURANCE

- A. Testing Firm's Qualifications:
  - 1. Corporately and financially independent organization which can function as an unbiased testing authority.
  - 2. Professionally independent of manufacturers, suppliers, and installers of electrical equipment and systems being tested.
  - 3. Employer of engineers and technicians regularly engaged in testing and inspecting of electrical equipment, installations, and systems.
  - 4. Supervising engineer accredited as Certified Electrical Test Technologist by National Institute for Certification of Engineering Technologies (NICET), or International electrical Testing Association and having a minimum of five (5) years testing experience on similar projects.
  - 5. Technicians certified by NICET or NETA.
  - 6. Assistants and apprentices assigned to project at ratio not to exceed two (2) certified to one (1) noncertified assistant or apprentice.
  - 7. Registered Professional Engineer to provide comprehensive project report outlining services performed, results of such services, recommendations, actions

taken, and opinions.

8. In compliance with OSHA 29 CFR Part 1907, "Criteria for Accreditation of Testing Laboratories," or a full-member company of the International Electrical Testing Association.

9. Test equipment shall have an operating accuracy equal to, or greater than, requirements established by NETA ATS.

B. Test instrument calibration shall be in accordance with NETA ATS.

### 3.3 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment are to be:

1. Scheduled with Engineer prior to de-energization.

2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify Engineer at least 24 hours prior to performing any tests on energized electrical equipment.

### 3.4 INSPECTION AND TEST PROCEDURES

A. Switchgear Assembly:

1. Visual and mechanical inspection for:

a. Physical damage

b. Equipment nameplate information conformance with latest single line diagram and report discrepancies.

c. Proper alignment, anchorage and grounding.

d. Tightness of accessible bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instruction for proper foot pound levels.

e. Paint chips, dents, scratches, etc.

f. Insulator damage and contaminated surfaces.

g. Proper barrier and shutter installation and operation.

h. Proper operation of indicating devices.

i. Improper blockage of air cooling passages.

j. Integrity and contamination of bus insulation system.

k. Check nameplates for proper identification of:

1) Equipment title and tag number with latest one-line diagram.

2) Pushbuttons.

3) Control switches.

4) Pilot lights.

5) Control relays.

6) Circuit breakers.

7) Indicating meters.

l. Verify that fuse and/or circuit breaker ratings, sizes, and types conform to those specified.

m. Check bus and cable connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints.

1) Ohmic value to be zero.

- 2) Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
  - n. Check operation and sequencing of electrical and mechanical interlock systems by:
    - 1) Closure attempt for locked open devices.
    - 2) Opening attempt for locked closed devices.
    - 3) Key exchange to operate devices in off-normal positions.
  - o. Verify performance of each control device and feature.
  - p. Control wiring:
    - 1) Compare wiring to local and remote control and protective devices with elementary diagrams.
    - 2) Proper conductor lacing and bundling.
    - 3) Proper conductor identification.
    - 4) Proper conductor logs and connections.
  - q. Exercise all active components.
  - r. Perform phasing check on double-ended equipment to ensure proper bus phasing from each source.
2. Electrical tests:
- a. Insulation resistance test:
    - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7. 1. 1.
    - 2) Each phase of each bus section.
    - 3) Phase-to-phase and phase-to-ground for 1 minute.
    - 4) With switches and breakers open.
    - 5) With switches and breakers closed.
    - 6) Control wiring except that connected to solid state components.
    - 7) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
  - b. Overpotential test:
    - 1) Applied voltage and test procedure in accordance with ANSI C37.20.1.
    - 2) Each phase of each bus section.
    - 3) Phase-to-phase and phase-to-ground for 1 minute.
    - 4) Test results evaluated on a pass-fail basis.
  - c. Current injection tests:
    - 1) For entire current circuit in each section.
    - 2) Secondary injection for current flow of 1 ampere.
    - 3) Test current at each device.
  - d. Control wiring:
    - 1) Apply secondary voltage to all control power and potential circuits.
    - 2) Check voltage levels at each point on terminal boards and each device terminal.
  - e. Operational test:

- 1) Initiate all control devices.
- 2) Check proper operation of control system in each section.

3. Test values:

- a. Bolt torque levels shall be in accordance with values specified by manufacturer.
- b. Insulation resistance test to be performed in accordance with manufacturer's specified values.

B. Grounding Systems:

1. Visual and mechanical inspection for:

- a. Compliance with plans and specifications.
- b. Equipment and circuit grounds in motor control centers, panelboards, switchgear, and motors for proper connection and tightness.
- c. Ground bus connections in motor control centers, panelboards, switchgear, and control panels for proper termination and tightness.
- d. Effective transformer core and equipment grounding.
- e. Accessible connections to grounding electrodes for proper fit and tightness.  
Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

2. Electrical tests:

- a. Perform fall of potential test per IEEE Standard No. 81, Section 9.04 on the main grounding electrode or system.
- b. Perform the two (2) point method test per IEEE No. 81, Section 9.03 to determine the ground resistance between the main grounding system and all major electrical equipment frames, system neutral and/or derived neutral points. Equipment ground resistance shall not exceed main ground system resistance by 0.25 ohms.
- c. Alternate method: Perform ground continuity test between main ground system and equipment frame, system neutral and/or derived neutral point. This test shall be made by passing a minimum of test (IO) amperes D.C. current between ground reference system and the ground point to be tested. Voltage drop shall be measured and resistance calculated by voltage drop method.

3. Test values: The main ground electrode system resistance to ground should be no greater than one (1) ohm.

C. Low Voltage Cables - 600 Volts and Below:

1. Visual and mechanical inspection for:

- a. Physical damage and proper connection in accordance with single line diagram.
- b. Equipment nameplate data compliance with design plans or starter schedule.
- c. Overload heaters compliance with motor full load current for proper size.
- d. Tightness of bolted connections.
- e. Proper barrier and shutter installation and operation.
- f. Proper operation of indicating and monitoring devices.

- g. Proper overload protection for each motor.
- h. Improper blockage of air cooling passages.
- i. Proper operation of any draw out elements.
- j. Integrity and contamination of bus insulation system.
- k. Check door and device interlocking system by:
  - 1) Closure attempt of device when door is in OPEN position.
  - 2) Opening attempt of door when device is in ON or CLOSED position.
- l. Check nameplates for proper identification of:
  - 1) Equipment title and tag number with latest one-line diagram.
  - 2) Pushbuttons.
  - 3) Control switches.
  - 4) Pilot lights.
  - 5) Control relays.
  - 6) Circuit breakers.
  - 7) Indicating meters.
- m. Verify that fuse and/or circuit breaker sizes and types conform to these specifications.
- n. Verify that current and potential transformer ratios conform to these specifications.
- o. Check bus connections for high resistance by low resistance ohmmeter and calibrated torque wrench applied to bolted joints.
  - 1) Ohmic value to be zero.
  - 2) Bolt torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by manufacturer.
- p. Check operation and sequencing of electrical and mechanical interlock systems by:
  - 1) Closure attempt for locked open devices.
  - 2) Opening attempt for locked open devices.
  - 3) Key exchange to operate devices in off-normal positions.
- q. Verify performance of each control device and feature furnished as part of the motor control center.
- r. Control wiring:
  - 1) Compare wiring to local and remote control, and protective devices with elementary diagrams.
  - 2) Check for proper conductor lacing and bundling.
  - 3) Check for proper conductor identification.
  - 4) Check for proper conductor lugs and connections.
- s. Exercise all active components.
- t. Inspect contactors for:
  - 1) Correct mechanical operations.
  - 2) Correct contact gap, wipe, alignment, and pressure.
  - 3) Correct torque of all connections.
- u. Compare overload heater rating with full-load current for proper size.

- v. Compare fuse, motor protector, and circuit breaker with motor characteristics for proper
- w. Perform phasing check on double-ended motor control centers to ensure proper bus phasing from each source.
- x. Cable connections torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by the manufacturer.
- y. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
- z. Color coding conformance with specifications.
- aa. Proper circuit identification.
- bb. Proper lug type for conductor material.
- cc. Proper lug installation.
- dd. Proper shield grounding on shielded instrumentation cable.
- ee. Proper terminations.
- ff. Proper circuit identification.
- gg. Proper termination of neutrals and grounds for correct operation of protective devices.

## 2. Electrical tests:

- a. Insulation resistance tests:
  - 1) Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
  - 2) Test each conductor with respect to ground and to adjacent conductors per IEEE I 1 8 procedures for 1 minute.
  - 3) Evaluate ohmic values by comparison with conductors of same length and type.
  - 4) Investigate any values less than 50 megohms.
  - 5) Measure insulation resistance of each control circuit with respect to ground.
  - 6) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
  - 7) Bus section phase-to-phase and phase-to-ground for 1 minute on each phase.
  - 8) Contactor phase-to-ground and across open contacts for 1 minute on each phase.
  - 9) Starter section phase-to-phase and phase-to-ground on each phase with starter with starter contacts closed and protective devices open.
  - 10) Test values to comply with NETA ATS, Table 10.2.
- b. Overpotential tests:
  - 1) Maximum applied voltage in accordance with NETA ATS, Table 7.1.2.
  - 2) Phase-to-phase and phase-to-ground for 1 minute for each phase of each bus section.
  - 3) Test results evaluated on pass/fail basis.
- c. Current injection through overload unit at 300 percent of motor full-load current and monitor trip time:

- 1) Trip time in accordance with manufacturer's published data.
  - 2) Investigate values in excess of 120 seconds.
- d. Control wiring tests:
- 1) Apply secondary voltage to all control power and potential circuits.
  - 2) Check voltage levels at each point on terminal boards and each device terminal.
  - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that connected to solid state components.
  - 4) Insulation resistance to be 1 megohm minimum.

3. Test values:

- a. Insulation resistance tests shall be performed at 1,000 volts D.C. for one-half (1/2) minute.
- b. Bolt torque levels shall be in accordance with manufacturer's specifications unless otherwise specified by manufacturer.
- c. Control wiring insulation test voltage shall be 500 V D.C. Manufacturer shall be consulted for test voltage where solid state control devices are utilized.
- d. Overload tests shall be made at three hundred percent (300%) of motor full load current. Trip times shall be in accordance with manufacturers tolerances. Values in excess of one hundred twenty (120) seconds shall be investigated.
- e. Insulation tests shall be made prior to termination.

D. Transformers:

1. General: Inspection and testing limited to motors rated 1/2HP and larger.

2. Visual and mechanical inspection for:

- a. Physical and insulator damage.
- b. Equipment nameplate information compliance with latest single line diagram and report discrepancies.
- c. Perform specific inspections and mechanical tests as recommended by manufacturer.
- d. Proper winding connections.
- e. Bolt torque level in accordance with NETA ATS, Table 1O. 1, unless otherwise specified by manufacturer.
- f. Defective wiring.
- g. Proper operation of fans, indicators, and auxiliary devices.
- h. Removal of shipping brackets, fixtures, or bracing.
- i. Free and properly installed resilient mounts.
- j. Cleanliness and improper blockage of ventilation passages.
- k. Correct tap-changer ratio setting for rated output voltage under normal operating conditions.
- l. Proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.
- m. Dissolved Gas Analysis (DGA Di-electric test, and moisture content test of oil.

3. Electrical tests:

- a. A dielectric absorption test shall be made on motor and starter circuit. Polarization index shall be determined for motor winding.
- b. A dielectric absorption test shall be made on motor winding. The thirty-sixty (30/60) second ratio shall be determined.
- c. Insulation resistance tests:
  - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7.2.3 for each:
    - a) Winding-to-winding.
    - b) Winding-to-ground.
  - 2) 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
  - 3) Results temperature corrected in accordance with NETA ATS, Table 7.2.4.
  - 4) Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
  - 5) Insulation resistance test results to compare within 1 percent of adjacent windings.
- d. Perform tests and adjustments for any fans, controls, and alarm functions as suggested by manufacturer.
- e. Measure secondary voltages and adjust taps as directed by Engineer.
- f. Turn to turn electrical testing for transformer integrity.
- g. Measure no load and full load running current and voltage and compare to nameplate.
- h. Observe proper operation and sequence of any reduced voltage starters.
- i. Perform vibration base line test on motors greater than 50 HP. Amplitude to be plotted vs. frequency.
- j. Perform vibration amplitude test on motors greater than 50 HP.
- k. Check all protective devices in accordance with other sections of these specifications.
- l. Perform over potential test on winding to ground.
- m. The measurement shall be made with a 1,000 volt megohmmeter; however, the precautions noted in the tests for conductor test shall also be applied to the motors.
- n. Insulation with resistance less than 10 megohms is not acceptable.
- o. Measurements shall be recorded in a format similar to Form 26 05 08 - B, contained in this section.
- p. After start-up of each motor, the current on each phase shall be measured.
  - 1) At no load.
  - 2) At defined load.
  - 3) In-rush current.
  - 4) Use Form 26 05 08 - B.

#### 4. Test Values:

- a. Dielectric absorption tests shall be made in accordance with test voltage



listed as specified by manufacturer. Polarization tests shall be for a ten (10) minute duration. Sixty/thirty (60/30) second ratio tests shall be for a one (1) minute duration. Polarization index readings less than three shall be investigated. Sixty/thirty(60/30)second ratio readings less than 1.4 shall be investigated.

- b. Motor measured full load current shall not exceed nameplate value.
- c. Over potential test shall be made an eighty percent (80%) of twice rated voltage plus one thousand (1,000) volts.
- d. Vibration amplitudes shall not exceed values furnished by manufacturer.

E. Lighting:

- 1. Verify that the switching, including remote control is as shown.
- 2. Verify that the circuitry is in accordance with the panel schedules.
- 3. Verify that load is balanced as closely as possible.
- 4. Verify that the lighting fixtures are located to minimize obstruction of illumination by liquid-filled mechanical equipment or building structural elements.
- 5. Verify that photocell operates properly.
- 6. Replace all lamps that do not operate properly.

F. Switches:

1. Visual and mechanical inspection for:

- a. Proper blade pressure and alignment.
- b. Proper operation of switch operating handle.
- c. Adequate mechanical support for each fuse.
- d. Proper contact-to-contact tightness between fuse clip and fuse.
- e. Cable connection bolt torque level in accordance with NETA ATS, Table 10.1.
- f. Proper phase barrier material and installation.
- g. Proper fuse sizes and types as shown on single line diagram.
- h. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

2. Electrical tests:

a. Insulation resistance tests:

- 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.
- 2) Phase-to-phase and phase-to-ground for 1 minute on each pole.
- 3) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.

b. Contact resistance tests:

- 1) Contact resistance in microhms across each switch blade and fuse holder.
- 2) Investigate deviation of 50 percent or more from adjacent poles or similar switches.

G. Low Voltage Cables - 600 Volts and Below:

1. Visual and mechanical inspection for:

- a. Physical damage and proper connection in accordance with single line diagram.

- b. Cable connections torque level in accordance with NETA ATS, Table 10.1, unless otherwise specified by the manufacturer.
- c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
- d. Color coding conformance with specifications.
- e. Proper circuit identification.
- f. Proper lug type for conductor material.
- g. Proper lug installation.
- h. Proper shield grounding on shielded instrumentation cable.
- i. Proper terminations.
- j. Proper circuit identification.
- k. Proper termination of neutrals and grounds for correct operation of protective devices.

2. Electrical tests:

- a. Insulation resistance tests:
  - 1) Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
  - 2) Test each conductor with respect to ground and to adjacent conductors per IEEE I 1 8 procedures for 1 minute.
  - 3) Evaluate ohmic values by comparison with conductors of same length and type.
  - 4) Investigate any values less than 50 megohms.
- b. Perform continuity test to insure proper cable connection.
- c. Measurements shall be made prior to connection of wires to any equipment. Ends of wires are to be taped with Scotch 33+ and be physically remote from all grounded surfaces by a minimum of 2".
- d. Insulation resistance measurements shall be recorded using the following table.

PANEL DESIGNATION: UL4A	LOCATION: West Closet A
-------------------------	-------------------------

CIRCUIT	LOAD	CKT. CONF.	OUTLET TEST	WIRE SIZE	AMPS	MEGOHMS
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						

12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						

- e. Insulation with resistance of less than 10 megohms is typically not acceptable.
- f. Insulation resistance test shall be performed at 1,000 volts dc for one-half (1/2) minute. Insulation resistance readings shall be recorded after the one-half minute time interval has elapsed.
- g. If in the opinion of the Engineer the test results are unacceptable, the Contractor will correct the installation, material or labor at no additional cost to, and to the satisfaction of, the Engineer.

3. Test values:

- a. Insulation resistance tests shall be performed at 1,000 volts D.C. for one-half (1/2) minute.
- b. Insulation tests shall be made prior to termination.

H. Dry type Transformers:

1. Visual and mechanical inspection for:

- a. Physical and insulator damage.
- b. Equipment nameplate information compliance with latest single line diagram and report discrepancies.
- c. Perform specific inspections and mechanical tests as recommended by manufacturer.
- d. Proper winding connections.
- e. Bolt torque level in accordance with NETA ATS, Table IO. 1, unless otherwise specified by manufacturer.
- f. Defective wiring.
- g. Proper operation of fans, indicators, and auxiliary devices.
- h. Removal of shipping brackets, fixtures, or bracing.
- i. Free and properly installed resilient mounts.
- j. Cleanliness and improper blockage of ventilation passages.
- k. Correct tap-changer ratio setting for rated output voltage under normal

- operating conditions.
  - I. Proper secondary voltage phase-to-phase and phase-to-ground after energization and prior to loading.
- 2. Electrical tests:
  - a. Insulation resistance tests:
    - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 7.2.3 for each:
      - a) Winding-to-winding.
      - b) Winding-to-ground.
    - 2) 10-minute test duration with resistances tabulated at 30 seconds, 1 minute, and 10 minutes.
    - 3) Results temperature corrected in accordance with NETA ATS, Table 7.2.4.
    - 4) Temperature corrected insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
    - 5) Insulation resistance test results to compare within 1 percent of adjacent windings.
  - b. Perform tests and adjustments for any fans, controls, and alarm functions as suggested by manufacturer.
  - c. Measure secondary voltages and adjust taps as directed by Engineer.
- I. Lighting:
  - 1. Verify that the switching, including remote control is as shown.
  - 2. Verify that the circuitry is in accordance with the panel schedules.
  - 3. Verify that load is balanced as closely as possible.
  - 4. Verify that the lighting fixtures are located to minimize obstruction of illumination by liquid-filled mechanical equipment or building structural elements.
  - 5. Verify that photocell operates properly.
  - 6. Replace all lamps that do not operate properly.
- J. Safety Switches, 600 volts maximum.
  - 1. Visual and mechanical inspection for:
    - a. Proper blade pressure and alignment.
    - b. Proper operation of switch operating handle.
    - c. Adequate mechanical support for each fuse.
    - d. Proper contact-to-contact tightness between fuse clip and fuse.
    - e. Cable connection bolt torque level in accordance with NETA ATS, Table 10.1.
    - f. Proper phase barrier material and installation.
    - g. Proper fuse sizes and types as shown on single line diagram.
    - h. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.
  - 2. Electrical tests:
    - a. Insulation resistance tests:
      - 1) Applied megohmmeter dc voltage in accordance with NETA ATS, Table 10.2.

- 2) Phase-to-phase and phase-to-ground for 1 minute on each pole.
    - 3) Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
  - b. Contact resistance tests:
    - 1) Contact resistance in microhms across each switch blade and fuse holder.
    - 2) Investigate deviation of 50 percent or more from adjacent poles or similar switches.
- K. Control Stations:
  - 1. Visual and mechanical inspection for:
    - a. Physical damage.
    - b. Proper installation.
    - c. Proper type and gasketing.
    - d. Proper operation of pushbutton(s) and/or selector switch(es).
    - e. Proper identification on nameplate.
    - f. Proper control wiring:
      - 1) Compare to elementary diagram.
      - 2) Check for proper termination.
      - 3) Check for proper conductor identification.
  - 2. Electrical tests:
    - a. Control wiring tests:
      - 1) Apply proper voltage to all circuits.
      - 2) Check voltage levels at each termination.
      - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that which is connected to solid state components. Insulation resistance to be one (1) megohm minimum.
    - b. Operational test by initiating control devices to affect proper operation.
- L. Local Control Panel(s) – LCP
  - 1. Visual and mechanical inspection for:
    - a. Physical damage.
    - b. Proper type and installation of cabinet.
    - c. Proper door closure and gasketing.
    - d. Proper operation of pushbutton(s) and/or selector switch(es).
    - e. Compliance with elementary diagrams and manufacturer's drawings.
    - f. Proper identification on nameplates.
    - g. Proper labeling of all devices both inside and outside.
    - h. Proper control wiring:
      - 1) Compare to elementary diagram.
      - 2) Check for proper termination.
      - 3) Check for proper conductor identification.
    - i. Proper overload protection for motor(s) when its starter is included in the panel.
    - j. Proper breaker size and type.
    - k. Proper CT when required.

- I. Proper terminal blocks.
  - 2. Electrical tests:
    - a. Control wiring tests:
      - 1) Apply proper voltage to all circuits.
      - 2) Check voltage levels at each termination.
      - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that connected to solid state components. Insulation resistance to be one (1) megohm minimum.
    - b. Operational test by initiating control devices to affect proper operation of each control signal and discrete signal loop.
- M. Operating and Control System
  - 1. Visual and mechanical inspection for:
    - a. Physical damage.
    - b. Proper type and installation of cabinet.
    - c. Proper door closure and gasketing.
    - d. Proper operation of pushbutton(s) and/or selector switch(es).
    - e. Compliance with P&IDs and manufacturer's drawings.
    - f. Proper identification on nameplates.
    - g. Proper labeling of all devices both inside and outside.
    - h. Proper control wiring:
      - 1) Compare to elementary diagram.
      - 2) Check for proper termination.
      - 3) Check for proper conductor identification.
    - i. Proper terminal blocks.
    - j. Equipment in compliance with these specifications.
    - k. Operating equipment in compliance with these specifications.
    - l. Operating screens in compliance with approved manufacturer's drawings.
    - m. Annunciator screens in compliance with approved manufacturer's drawings.
    - n. Alarm logs in compliance with approved manufacturers drawings.
  - 2. Electrical tests:
    - a. Control wiring tests:
      - 1) Apply proper voltage to all circuits.
      - 2) Check voltage levels at each termination.
      - 3) Insulation resistance test at 1,000 volts dc on all control wiring except that which is connected to solid state components. Insulation resistance to be one (1) megohm minimum.
    - b. Operational test by initiating control devices to affect proper operation.

### 3.5 ADJUSTING

- A. Subsystem Testing:
  - 1. Shall occur after the proper operation of alarm and status contacts has been demonstrated and observed by the Engineer.
  - 2. Shall occur after the process and control devices have been adjusted as

- accurately as possible.
3. It is intended that the Contractor shall adjust limit switches and level switches to their operating points prior to testing and will set pressure switches, flow switches, and timing relays as dictated by operating results.
  4. After initial settings have been completed:
    - a. Each subsystem shall be operated in the manual mode and it shall be demonstrated that operation is in compliance with the Contract documents.
    - b. After the manual mode of operation has been proven, automatic operation shall be demonstrated to verify such items as proper start and stop sequence of pumps, proper operation of valves, proper speed control, etc.
  5. Subsystems, in the context discussed here, shall mean individual and groups of pumps, conveyor systems, chemical feeders, air conditioning units, ventilation fans, air compressors, blowers, etc.

### **3.6 DEMONSTRATION**

- A. Commissioning:
  1. Commissioning during the startup, shall not be attempted until all subsystems have been found to operate satisfactorily.
  2. Commissioning shall only be attempted as a function of normal plant operation in which plant process flows and levels are routine and equipment operates automatically in response to flow and level parameters or computer command, as applicable.
  3. Simulation of process parameters shall be considered only upon receipt of a written request by the Contractor.
- B. Motor current tabulation report shall reflect the values occurring during commissioning.
- C. The indications of all switchgear ammeters and kilowatt meters, shall be recorded every half-hour during commissioning.

### **END OF SECTION**

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**SECTION 26 05 09**  
**ELECTRICAL IDENTIFICATION**

**PART 1 - GENERAL**

**1.1 SCOPE**

A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

1. Nameplates.
2. Labels.
3. Wire and cable markers.
4. Conduit markers.

**1.2 APPLICABLE SECTIONS:**

A. Section 26 05 00 - Electrical General Requirements.

**1.3 SUBMITTALS:**

A. Submit product literature including manufacturer name, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.

**PART 2 - PRODUCTS**

**2.1 NAMEPLATES:**

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.

B. Locations:

1. Each electrical distribution and control equipment enclosure.
2. Communication cabinets.
3. Each junction box.

C. Letter Size:

1. 1/8" letters for identifying individual equipment and loads.
2. 1/4" letters for identifying grouped equipment and loads.

D. Identify control device stations, motor control equipment, process equipment and instrumentation equipment. All such devices shall be labeled with equipment served, identifying name, and circuit number with panel.

## 2.2 WIRE MARKERS:

### A. Manufacturers:

1. 3M
2. Thomas & Betts
3. Panduit

### B. Description: Heat shrink tubing, imprinted, type wire markers.

### C. Locations: Each conductor at panel-board gutters, pull boxes, outlet and junction boxes, and each load connection, PLC panels, instrument panels, instruments, MCC's, etc.

### D. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number shall be indicated on project Record Drawings.

### E. Control Circuits: Control wire number shall be indicated on schematic and interconnection diagrams.

### F. Data Wiring: Address number shall be indicated on each end of conductor on the face of the outlet cover, and on the space of the patch panel.

### G. All conductor numbers and terminal block numbers shall be reflected on the CONTRACTOR submitted Record Drawings.

## 2.3 CONDUIT MARKERS:

### A. Manufacturers:

1. Tech Products
2. Thomas & Betts
3. Panduit

### B. Description: 3/16" poly tag in poly tag holder. Tie wrapped to conduit.

### C. Location: Furnish markers for each conduit longer than 6 feet.

### D. Spacing: Label at each junction and terminal end.

### E. Legend: Number as indicated in contractor prepared Record Drawings.

## 2.4 UNDERGROUND WARNING TAPE:

### A. Description: 4" wide detectable plastic tape, colored red with suitable warning legend describing buried electrical lines.

### B. Location: Along length of each underground conduit, 12" above conduit.

## 2.5 LABELS:

- A. Self adhesive, plastic coated, machine printed.
- B. Manufacturer: Brother or equal.
- C. Locations:
  - 1. Convenience outlet circuit adhered to outlet faceplate showing panel and circuit number.
  - 2. Data address number to outlet faceplate and patch panel face plate.
  - 3. Light switches, indicating lighting switched panel and circuit number.
  - 4. Process wiring indicating connection point terminal block and cabinet.

## **PART 3 - EXECUTION**

### 3.1 PREPARATION:

- A. De-grease and clean surfaces to receive nameplates and labels.

### 3.2 INSTALLATION:

- A. Install nameplate and label parallel to equipment lines.
- B. Secure nameplate to equipment front using screws.
- C. Secure nameplate to inside surface of door on panel-board that is recessed in finished locations.
- D. Identify each conduit at each end.
- E. Identify underground conduits using one underground warning tape per trench at 12" above conduit.

**END OF SECTION**

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**SECTION 26 05 19**  
**CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish and install conductors and cables as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

**1.2 SUBMITTALS**

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.

**1.3 QUALITY ASSURANCE**

- A. **MANUFACTURERS:** Firms regularly engaged in manufacture of conduits and raceway systems of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
- B. **STANDARDS:** Comply with applicable portions of the NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

**1.4 APPLICABLE SECTIONS**

- A. Section 26 05 00: Electrical General Requirements.
- B. Section 26 05 08: Electrical Acceptance Tests

**PART 2 - PRODUCTS**

**2.1 COMPONENTS**

- A. 600 Voltage Conductors:
  - 1. Copper with AWG sizes as shown or required:
    - a. Minimum size shall be No. 12 except where specified otherwise.
    - b. Conductors shall be stranded.
      - 1) Insulation:
        - a) Conductor Size No. 2 And Smaller: 600V type THWN or XHHW (75°
        - C). All conductors run in underground conduits shall be XHHW.

b) Conductor Size No. 1 And Larger: 600V Type XHHW-2 (90° C).

2) Colors:

a) 120/240 V System

- (1) Black: Line 1.
- (2) Red: Line 2.
- (3) Green: Ground.
- (4) White: Neutral.

b) 208Y / 120 V System:

- (1) Black: Phase A.
- (2) Red: Phase B.
- (3) Blue: Phase C.
- (4) Green: Ground.
- (5) White: Neutral.

c) 480Y / 277 Volt System:

- (1) Brown: Phase A.
- (2) Orange: Phase B.
- (3) Yellow: Phase C.
- (4) Neutral: Gray.
- (5) Ground: Green.

d) Conductors size No. 10 and smaller shall be colored full length. Tagging or other methods for coding of conductors size No. 10 and smaller not allowed.

e) For feeder conductors larger than No. 10 at pull boxes, gutters, and panels, use taped band or color tag color-coded as specified above.

B. Instrumentation Cables:

1. Instrument cable shall be Type TC, and have the number of individually shielded twisted pairs indicated on the Drawings and shall be insulated for not less than 600 volts. Unless otherwise indicated, conductor size shall be No. 18 AWG minimum. Shielded, grounded instrumentation cable shall be used for all analog and low voltage digital signals.
2. The jacket shall be flame retardant with 90 degrees C temperature rating. The cable shield shall be a minimum of 2.3 mil aluminum or copper tape overlapped to provide 100 percent coverage and a tinned copper drain wire.
3. The conductors shall be bare soft annealed copper, Class B, 7 strand minimum concentric lay with 15 mils nominal thickness, nylon jacket, 4 mil nominal thickness, 90 degrees C temperature rating. One conductor within each pair shall be numerically identified.

4. Pairs shall be assembled with a nominal 2-inch lay and shall then be group shielded with a minimum of 1.3 mil aluminum or copper tape overlapped to provide 100 percent coverage. All group shields shall be completely isolated from each other.

C. Control Wires:

1. Copper with AWG sizes as shown or required:
  - a. Minimum size shall be No. 14 except where specified otherwise.
  - b. Conductors shall be stranded.
    - 1) Insulation:
      - a) 600V type THWN or XHHW (75° C). All conductors run in underground conduits shall be XHHW.
2. Control wires may be run in same conduits as instrumentation cables.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

A. General:

1. Conductors and cables shall be continuous from source to equipment.
2. Do not use direct burial cable.
3. Instrumentation and control wires shall be run in conduits separate from power conduits.

B. 600 Voltage Conductors:

1. Install conductors in raceway except where specifically indicated otherwise. Run conductors of different voltage systems in separate conduits. All raceways shall include an equipment ground conductor.
2. Route circuits at own discretion, however, circuiting shall be as indicated or required. Group circuit homeruns to panels as shown on Drawings. No other groupings of circuits will be allowed.
3. Neutrals:
  - a. On three-phase, 4-wire systems: Do not use common neutral for more than one three phase circuit.
  - b. On single-phase, 3-wire systems: Do not use common neutral for more than one circuit per phase.
  - c. Run separate neutrals for each circuit where specifically noted on Drawings.
  - d. Where common neutral is run for two or three home run circuits, connect phase conductors to breakers in panel which are attached to separate phase legs so neutral conductors will carry only unbalanced current. Neutral shall be sized at 200% of full load.
4. Pulling Conductors:

- a. Do not pull conductors into conduit until raceway system is complete and enclosures, cabinets, and boxes are free of foreign matter and moisture.
  - b. Install conductors in accordance with the manufacture's requirements.
  - c. Use only listed non-hardening wire pulling lubricants.
- 5. Provide positive supports for conductors in vertical raceways at following spacing minimum, unless shorter is recommended by manufacturer.
  - a. No. 18 to 1/0 100 feet.
  - b. No. 2/0 to 4/0 80 feet.
  - c. 250MCM to 350MCM 60 feet.
  - d. 350MCM to 500MCM 50 feet.
- C. Feeder and branch circuits shall be isolated from each other, and from instrumentation and control circuits. Instrumentation cables shall be installed in separate raceways from other cables and wiring. This includes portions running through manholes. Instrumentation cable shall be continuous between instruments or between field devices and instrument enclosures. There shall be no intermediate splices or terminal boards, unless otherwise shown on the Drawings.
- D. Maintain electrical continuity of the shield when splicing twisted shielded pair conductors. Drain wires shall be terminated inside enclosures at grounded terminal blocks. Only one end of each instrument loop cable drain wire shall be grounded. Ground drain wire of shielded conductors at one end only.
- E. Terminate instrumentation and control wiring, including spare wires, at control panels and motor control centers on terminal boards mounted inside the equipment.
  - 1. CONTRACTOR shall supply terminal boards as required.
  - 2. Do not field wire directly to devices.
- F. Low Voltage Cables In Office Spaces (70 Volts or Less):
  - 1. In inaccessible, concealed spaces, run cables in raceway. In accessible, unfinished areas, cables may be run exposed without raceway.
  - 2. Run exposed cables parallel to or at right angles to building structure lines. Do not run exposed cables on floors or in such a way that they obstruct access to, operation of, or servicing of equipment. Keep cables 6 inches minimum from hot water pipes.
    - a. Support cables every 3 feet with permanent clips, straps, staples, or tie wraps approved for application and which will not cause cables to be pinched or deformed.
    - b. Securely attach clips and straps with nails or screws. Do not use wire or tape to support cables.
  - 3. Bundle only cables of same systems together.

## END OF SECTION



**SECTION 26 05 22**  
**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish and install wiring devices as required, and as shown on the Drawings.  
Materials employed shall be as indicated on the Drawings and specified herein.

**1.2 SUBMITTALS**

- A. Submit product literature including manufacturer, model or part number, materials of construction, size, ratings, and listings as a minimum.

**1.3 QUALITY ASSURANCE**

- A. NECA - Standard of Installation.
- B. NEMA WD 1 - General Requirements for Wiring Devices.
- C. NEMA WD 6 - Wiring Device -Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.
- E. UL - Underwriters Laboratories, Inc.

**PART 2 - PRODUCTS**

**2.1 WALL SWITCHES**

- A. Manufacturers:
  - 1. Hubbell, Model HBL-1221, 1223, 1224 series.
  - 2. Arrow Hart, Model 1991.
- B. Description: NEMA WD 1, Heavy-Duty Specification Grade AC only general-use snap switch.
- C. Body and Handle: Gray plastic with toggle handle.
- D. Indicator Light: Lighted handle type switch red color handle.
- E. Locator Light: Lighted handle type switch; red color handle.
- F. Ratings:
  - 1. Voltage: 120-277 volts, AC.
  - 2. Current: 20 amperes.

**2.2 RECEPTACLES**

- A. Manufacturers:
  - 1. Hubbell, Model HBL 5362-SP.
  - 2. Arrow Hart, Model 5362-CR.
- B. Description: NEMA WD 1, Heavy-duty specification grade general use receptacle.
- C. Device Body: Gray plastic.
- D. Configuration: NEMA WD 6, type as specified and indicated.

- E. Convenience Receptacle: Type 5-20.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

## 2.3 WALL PLATES

- A. Decorative Cover Plate: Brushed stainless steel in electrical/control/blower rooms.
- B. Process Room/Exterior Cover Plate: Gasketed cast metal with hinged gasketed device cover. Lever type switch cover. Classified hazardous as required for process areas per drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that outlet or device boxes are installed at proper height.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

### 3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from outlet boxes.

### 3.3 INSTALLATION

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

### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Install wall switch 48 inches above finished floor.
- B. Install convenience receptacle 18 inches above finished floor unless otherwise indicated.
- C. Install convenience receptacle 6 inches above back-splash of counter.
- D. Install dimmer 48 inches above finished floor.

- E. Install telephone jack 18 inches above finished floor.
- F. Install telephone jack for side-reach wall telephone to position top of telephone at 54 inches above finished floor.
- G. Install telephone jack for forward-reach wall telephone to position top of telephone at 48 inches above finished floor.

### 3.5 FIELD QUALITY CONTROL

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

### 3.6 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

### 3.7 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

**END OF SECTION**

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**SECTION 26 05 24**  
**EQUIPMENT WIRING**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
1. This section includes wiring connections to equipment specified in other sections.
  2. Electrical connections to equipment: Provide the materials and make the electrical connections to all equipment having electrical requirements as indicated in the architectural and/or mechanical section of the specifications and drawings.
  3. Provide conduit, wiring, connect motors and other mechanical equipment and electrical devices in other sections; also install, provide, support for, and connect starters, other control devices, control panels, furnished for such motors and equipment; complete all circuit leave in satisfactory operating conditions.
  4. Provide control devices for equipment in addition to those furnished by the trades providing such equipment; refer to schedules on electrical and mechanical drawings for control devices to be furnished under scope of the electrical work.
  5. Control devices and panels furnished by trades providing equipment will be delivered to electrician at site of project; acknowledge acceptance in writing; assume responsibility for particular installation before proceeding with installing and wiring them. Follow each manufacturer's printed installation directions and wiring diagrams for installing and making connections to his equipment and controls.
  6. Consult contract drawings and specifications of trades providing equipment and controls, for control wiring diagrams, also refer to their shop drawings in order to become familiar with equipment type and operation of controls, their locations and extent of work required for installing, wiring and connecting them.
  7. Starters for all motors requiring same shall be furnished by electrical contractor.

**1.2 APPLICABLE SECTIONS**

- A. The General Conditions, Supplementary Conditions, Special Conditions, alternates, and addenda, applicable drawings, and the specifications including but not limited to the following:
1. Section 26 05 00 - Electrical General Requirements.

**1.3 REFERENCES**

- A. Section 01 50 00 - Quality Control:
- B. NEMA WD 1 - General Purpose Wiring Devices.
- C. NEMA WD 6 - Wiring Devices - Dimensional Requirements.
- D. NFPA 70 - National Electrical Code.

**1.4 SUBMITTALS FOR REVIEW**

- A. Section 01 33 00 – Submittals: General.

- B. Section 26 05 00 – Electrical General Requirements.
- C. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

#### 1.5 REGULATORY REQUIREMENTS

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

#### 1.6 COORDINATION

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

### **PART 2 - PRODUCTS**

#### 2.1 CORDS AND CAPS

- A. Manufacturers:
  - 1. Hubbell.
  - 2. Or equal.
- B. Attachment Plug Construction: Conform to NEMA WD 1.
- C. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- D. Cord Construction: NFPA 70, Type SJO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- E. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit over-current protection.

### **PART 3 - EXECUTION**

#### 3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energizing

#### 3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible Metal (LFMC) conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.

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

**END OF SECTION**

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**SECTION 26 05 26**  
**GROUNDING AND BONDING**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
  - 1. Grounding electrodes and conductors.
  - 2. Equipment grounding conductors.

**1.2 APPLICABLE SECTIONS**

- A. The General Conditions, Supplementary Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following:
  - 1. Section 26 05 00 - Electrical General Requirements.

**1.3 REFERENCES**

- A. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- B. NFPA 70 - National Electrical Code.

**1.4 GROUNDING SYSTEM DESCRIPTION**

- A. Metal underground water pipe.
- B. Metal frame of the building.
- C. Concrete-encased electrode.
- D. Rod electrode.
- E. Plate electrode.
- F. Active electrode.

**1.5 PERFORMANCE REQUIREMENTS**

- A. Grounding System Resistance: 25 ohms maximum.

**1.6 SUBMITTALS FOR REVIEW**

- A. Section 01 30 00 – Submittals: General.
- B. Section 26 05 00 - Submittals: Procedures for submittals.
- C. Product Data: Provide for grounding and bonding equipment.
- D. All submittals shall include a list of all items being submitted by description, manufacturer and catalog number.

## 1.7 SUBMITTALS FOR CLOSEOUT

- A. Section 26 05 05 - Operation and Maintenance Manuals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.
- C. Certificate of Compliance: Indicate approval of installation by the authority having jurisdiction.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 5 years documented experience.

## 1.9 REGULATORY REQUIREMENTS

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

# PART 2 - PRODUCTS

## 2.1 ROD ELECTRODES

- A. Material: Copper Clad Steel.
- B. Diameter: 5/8 inch.
- C. Length: 10 feet (3000 mm).

## 2.2 CONNECTORS

- A. Manufacturers:
  - 1. T&B
  - 2. Burndy - Hi-Ground
  - 3. ERICO® - Cadweld®
- B. Material: Irreversible Crimp Style or Exothermic Weld.

## 2.3 WIRE

- A. Material: Stranded copper, tinned.
- B. Grounding Electrode Conductor: Size as indicated in the Drawings, or if modified or not indicated, size to meet NFPA 70 requirements.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

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

## 3.2 INSTALLATION

- A. Install electrodes at locations indicated and in accordance with manufacturer's instructions. Install additional rod electrodes as required to achieve specified resistance to ground.
- B. Provide grounding electrode conductor (UFER) and connect to reinforcing steel in foundation footing. Bond steel together.
- C. Provide bonding to meet Regulatory Requirements.

### 3.3 FIELD QUALITY CONTROL

- A. Perform inspections and tests listed in NFPA ATS, Section 7.13.

**END OF SECTION**

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**SECTION 26 05 30**  
**CONDUIT**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish and install conduits and raceway systems as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein.

**1.2 SUBMITTALS**

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.
- C. Proposed location and details of construction for openings in slabs and walls for conduit runs.

**1.3 QUALITY ASSURANCE**

- A. **MANUFACTURERS:** Firms regularly engaged in manufacture of conduits and raceway systems of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
- B. **STANDARDS:** Comply with applicable portions of the NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

**1.4 PROJECT/SITE CONDITIONS**

**A. GENERAL:**

- 1. Unless otherwise specified, equipment and materials shall be sized and derated for ambient site conditions, but in no case less than an ambient temperature of 40 degrees C at an elevation ranging from seal level to 5,000 feet without exceeding the manufacturer's stated tolerances.

**B. AREA CLASSIFICATIONS**

- 1. For the purpose of delineating the basic electrical construction materials and installation requirements for this project, areas of the project have been classified on the contract drawings as defined below. Electrical work within these areas shall conform to the requirements described below as well as the referenced code requirements.

- a. General Purpose (NEMA 1): Areas requiring general purpose (NEMA 1) construction are indoor areas typically architecturally finished and occupied by plant personnel.
- b. Outdoor and Corrosive Process Areas (NEMA 4X): Areas requiring corrosion resistant (NEMA 4X) construction are all outdoor areas unless noted otherwise and all indoor corrosive process areas. Corrosive process areas typically contain pumping or piping systems and are subject to spills and washdown. Corrosive process areas shall also include those areas containing corrosive chemicals.
- c. Hazardous Areas (NEMA 7): Unless otherwise indicated on the contract drawings, areas requiring hazardous location (NEMA 7) construction are classified as Class 1, Division 2 or Class1, Division 1 hazardous locations per Articles 500 and 501 of the National Electrical Code. See classification drawings.
- d. Process Areas (NEMA 12): Areas requiring drip-proof (NEMA 12) construction are indoor process and support system areas and are not typically subject to spills, direct washdown, or corrosive chemicals under normal operating conditions.

#### C. CONSTRUCTION MATERIALS:

1. Construction materials required for each area classification are listed in table A below. Refer to the individual specification section for each component for material composition and installation practices.

Component	Area Classification				
	NEMA 1	NEMA 4X <sup>1</sup> Outdoor	NEMA 4X <sup>1</sup> Indoor Corrosive	NEMA 12 <sup>1</sup>	NEMA 7 Classified Explosion Proof/Process Area
Conduit (exposed)	GRS	RA <sup>7</sup> PGRS	RA PGRS	RA PGRS	PGRS
Conduit (concealed) <sup>4</sup>	EMT <sup>3</sup>	PGRS HDPE	RA	GRS	GRS
Flexible conduit <sup>5</sup>	LFS	LFS	LFN	LFN	Classified
Support systems	Galvanized Steel	Aluminum	Stainless steel	Aluminum	Stainless steel
Fastening hardware and hanger rods	Cadmium plated steel	Stainless steel	Stainless steel	Cadmium plated steel	Stainless steel

Control Stations <sup>2,6</sup>	Painted Steel	Non-Metallic	Non-Metallic	Painted Steel	Classified
Enclosures <sup>2,6</sup>	Painted Steel	Non-Metallic	Non-Metallic	Painted Steel	Classified
Receptacles <sup>2</sup> Surface Recessed	General General	WP8 WP8	WP8 N/A	WP8 WP8	Classified N/A
Switches <sup>2</sup> Surface Recessed	General General	WP8 WP8	WP8 N/A	WP8 WP8	Classified N/A

Notes:

1. Enclosures, device boxes, control stations and raceway systems shall be mounted with ¼-inch (minimum) space between the electrical system and supporting structure.
2. Conduit terminations to control stations, enclosures, and device boxes in NEMA 4X, 7 and 12 areas shall be made through threaded hubs.
3. Rigid conduit concealed in framed walls, block walls and ceiling spaces shall be electrical metallic tubing, type EMT.
4. Conduit ductbank or beneath slab on grade shall be rigid HDPE conduit, continuous from device to device without pullboxes or conduit splices beneath grade due to high water table..
5. Flexible conduit shall be utilized for final connections to equipment.
6. Control station and enclosure sealing ratings shall meet or exceed the rating designated by the area classification.
7. Exposed conduit systems in areas containing equipment handling Ferric Chloride shall be PGRS.
8. Use gasketed lever type switches and up-in use red dot steel receptacle covers.

Legend:

EMT	Electrical Metallic Tubing
GRS	Galvanized Rigid Steel
LFS	Liquid Tight Flexible Steel
LFN	Liquid Tight Flexible Non-Metallic
PGRS	PVC Coated Galvanized Rigid Steel
PVC4	PVC Schedule 40
PVC8	PVC Schedule 80
RA	Rigid Aluminum
WP	Weatherproof – Use cast device boxes with threaded hubs

XP	Explosion proof – Approved conduit systems per classification listing
N/A	Non applicable

## PART 2 - PRODUCTS

### 2.1 CONDUIT AND TUBING

- A. GENERAL: Provide conduit and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".
- B. ELECTRICAL METALLIC TUBING (EMT):
  - 1. Per UL "Standard for Electrical Metallic Tubing" No. 797. Galvanized mild steel with interior coat of enamel.
  - 2. Fitting shall be steel, compression type. Cast type or indenter type fittings are not acceptable.
  - 3. Approved for concealed interior locations of the Electrical Room.
- C. GALVANIZED RIGID METAL CONDUIT (GRC): FS WW-C-0581 and ANSI C80.1.
  - 1. Per USAS C80.1, zinc-coated by hot-dip galvanizing or sherardizing with additional enamel or lacquer coating.
  - 2. Couplings shall be threaded type of same material and finish as conduit. Connectors shall be Myers hubs or equal of same material and finish as conduit.
  - 3. Approved Locations: Interior where exposed, where not exposed to moisture or corrosive atmosphere.
- D. HIGH DENSITY POLYETHYLENE PLASTIC PIPE (HDPE), OR POLYVINYL CHLORIDE (PVC) SCHEDULE 40, Based on Outside Diameter:
  - 1. Conduit suitable for direct burial. 1" minimum size.
  - 2. Fittings shall be threaded, glued, or heat welded type of same material as conduit. No splices are allowed underground in locations with high water table.
  - 3. Approved for underground direct burial, May be used where buried in earth under floor slabs.
  - 4. Minimum depth of bury under slab shall be 18 inches or of sufficient depth to allow for bending radius to rise out of the slab vertically. Shall have an exposed grounding electrode conductor in each trench.
  - 5. Not approved for above grade installation nor for embedding in concrete slabs.
  - 6. Exterior underground conduits, all elbows shall be PVC coated GRS or Fiberglass.
  - 7. All buried conduit between VFDs and motors.
- E. PVC COATED GALVANIZED RIGID METAL CONDUIT (PGRC): NEMA RN 1.
  - 1. Rigid galvanized conduit, prior to plastic coating, shall conform to ANSI Standard C80.1, UL 6, and CSA Standard C22.2 #45.



2. Nominal thickness of exterior PVC coating shall be 40 mils. A two-part red urethane coating of 2 mil thickness shall be applied to the interior of all conduits and fittings.
3. All hollow conduit fittings which serve as part of the raceway system shall be coated with exterior PVC coating and red interior urethane coating as described above.
4. Coated conduit shall conform to NEMA Standard No. RN1-1989. Shall be "Plastic-Bond Red" as manufactured by Robroy Industries, Inc.
  - a. Approved Locations: Shall be used in all locations where conduits are buried, in contact with earth, and in wet and corrosive areas, and as noted on the drawings. All risers through concrete floors, all embedded conduit, and all elbows of ductbanks underground.

F. LIQUIDTIGHT FLEXIBLE METAL CONDUIT: UL 360.

1. Galvanized steel with an extruded liquidtight PVC cover that is moisture and oil-proof, and UV resistant.
2. Fittings shall be liquidtight compression type, listed for grounding. Provide fittings with external bonding jumper where required for bonding.
3. Approved for flexible connections to equipment subject to vibration such as motors, fan, pumps, dry transformers, etc., 36-inch maximum, 18" minimum length for each connection.

G. FLEXIBLE METAL CONDUIT: UL 1.

1. Galvanized steel.
2. Approved for flexible connections to equipment in unclassified areas of the Administration Building.

H. RIDGED ALUMINUM CONDUIT:

Couplings shall be threaded type of same material and finish as conduit. Connectors shall be Myers hubs or equal of same material and finish as conduit.  
Approved Locations: Interior where exposed, on the exterior exposed to moisture or corrosive atmosphere. Approved for above grade installation. May be used within the process area of the plant.

I. CONDUIT BODIES:

1. Form 7 malleable iron with hot dip galvanized finish, PVC coated in wet or process areas of plant.
2. Gasketed cast iron, zinc plated cover with stainless steel screws.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF ELECTRICAL RACEWAYS**

- A. General Requirements: Unless otherwise indicated, wiring shall consist of insulated conductors installed in conduits or raceways.

## 3.2 CONDUIT AND TUBING SYSTEMS

- A. Conduit and tubing systems shall be installed as indicated. Conduit sizes are based on the use of insulated, copper conductors. Minimum size of raceways shall be as noted. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. PVC coated rigid metal conduit will be used in damp, wet or corrosive locations and the conduit or tubing system will be provided with the appropriate boxes, covers, clamps, screws or other appropriate type of fittings. Any exposed threads or metal shall be touched up with 3 coats of touch up material provided with conduit. Raceways shall be kept 6" away from parallel runs of any mechanical piping. Raceways shall be concealed where possible. Raceways crossing structural expansion joints shall be provided with suitable expansion fittings and will provide continuity for grounding.

## 3.3 BELOW SLAB-ON-GRADE OR IN THE GROUND

- A. All electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing through slabs-on-grade shall be PVC coated rigid metal conduit. PVC conduits shall be installed below slab-on-grade or in the earth. All underground bends over 22° and risers through concrete slab shall be PVC coated GRC.

## 3.4 INSTALLED IN SLABS INCLUDING SLABS ON GRADE

- A. Conduit shall not be embedded in concrete slabs except as specifically detailed.

## 3.5 EXPOSED RACEWAYS

- A. Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above ceilings shall be considered as exposed installations.

## 3.6 CHANGES IN DIRECTION OF RUNS

- A. Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field made bends and offsets shall be made with an approved hickey or conduit bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp or wet locations shall be avoided where possible. Care shall be taken to prevent the lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment during the course of construction. Clogged raceways shall be entirely freed from obstructions or shall be replaced.

## 3.7 SUPPORTS

- A. Metallic conduits and tubing shall be securely and rigidly fastened in place at intervals of not more than 10' and within 3' of boxes, cabinets, enclosures, and fittings, with U-channel support systems, one hole conduit straps with clamp backs, and conduit hangers. All supports mounted in exterior, process, or exposed areas subject to corrosive atmosphere shall be stainless steel. Supports in other areas shall be hot dipped galvanized. C-clamps or beam clamps shall have strap or rod type retainers. Rigid plastic conduits (if permitted as wiring method) shall be supported as indicated above, except that they shall be supported at 3'-0" maximum on centers and as indicated in the NEC (NFPA 70). Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structures, but no load shall be applied to joist bridging.

- B. Fastenings shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a power charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or supports shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4" in concrete joints shall avoid cutting the main reinforcement bars. Holes not used shall be filled. In partitions of light steel construction, sheet metal screws shall be used. Conduits shall not be supported using wire or nylon ties.
- C. Raceways shall be installed as a complete system and shall be independently supported from the structure. Upper raceways shall not be supported of lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts and shall not be fastened to hung ceiling supports.
- D. Support Installations:
  - 1. U-channel supports generally are not detailed but must be adequate to support combined weights of conduit and conductors.
  - 2. Clamps: Galvanized malleable iron one-hole straps with clamp backs, beam clamps or other approved device with necessary bolts, expansion shields. Perforated metal straps shall not be used.
  - 3. Adjustable U-channel Supports: Used to support horizontal runs only, use trapeze hangers for parallel runs of conduits.
  - 4. Surface mounted raceway bases shall be anchored to ceiling members or block walls on 5'-0" centers maximum spacing and at all junction and device boxes and at angle fittings. Anchors shall be: Expansion shields on concrete or solid masonry, toggle bolts on hollow masonry units or on suspended ceilings.

### 3.8 INSTALLATION OF RACEWAYS AND FITTINGS:

- A. General:
  - 1. All Conduit: In accordance with requirement of National Electrical Code and applicable local codes.
  - 2. Steel Conduit: In accordance with recommendations of American Iron and Steel Institute "Design Manual on Steel Electrical Raceways," latest edition.
- B. Electrical Continuity:
  - 1. All metallic conduit systems shall be electrically continuous throughout.
- C. Moisture:
  - 1. All conduit systems shall be essentially moisture tight.
- D. Alignment of Exposed Conduit:
  - 1. Parallel with or at right angles to lines of structure.
- E. Field Cuts and Threads:

1. Cuts shall be square, threads clean and sharp. Remove sharp or rough edges by reaming burrs. Before couplings or fittings are attached, apply one coat of red lead or zinc chromate to male threads of rigid steel conduit. Apply coat of red lead, zinc chromate or special compound recommended by manufacturer of conduit where conduit protective coating is damaged.

F. Bends:

1. Uniform, whether job-fabricated or made with standard fittings or boxes. Do not dent or flatten conduit.
2. Exposed Conduit: Symmetrical insofar as practicable.

G. Location:

1. Routing: Generally shown in schematic fashion, unless dimensioned or noted to contrary. Contractor shall determine actual routing as approved.
2. Conduit Not Shown: Contractor shall route as required to connect equipment as specified.
3. Vertical Risers, Equipment and Device Locations: Approximately as shown. Contractor shall coordinate installation of conduit, in locations indicated, with structure and equipment.
4. Conduit in Relation to Steam or Hot Water Lines or Other Hot Surfaces: Locate minimum of 6" away. If such separation is impracticable, protect from heat as approved.

H. Buried Conduit:

1. Depth of Burial: Minimum of 24" below finished grade with warning tape 12" above conduit.

I. Wall Penetrations: Required for passage of conduits installed by CONTRACTOR through walls, or partitions.

1. Penetrations Through Exterior Building Walls: Cast in sleeve/Core drill wall and provided conduit entrance seals as detailed. All penetrations shall be with rigid steel conduit PVC coated within the plant process areas.
2. Openings Required Through Existing Partitions: Shall be provided at CONTRACTOR's expense. Holes through masonry construction shall be cast/drilled with suitable coring machine. Perform work neatly. Patches shall match original material in composition and appearance.
3. Provide fire seals where a fire rated partition or wall is penetrated.

J. Expansion Fittings:

1. Install in all conduit runs crossing structural expansion joint or in straight runs 75 feet or more in length.

K. Conduit Ends:

1. Cap spare conduits.

2. Open Conduit Ends Terminating in Switchboards, Cabinets or Similar Locations Where Exposed to Entrance of Foreign Material: Install insulating grounding bushing. Plug space around cables with sealing compound.
3. Cap or plug conduit ends to prevent entrance of foreign material during construction.

L. Conduit Connections:

1. Cabinets, Enclosures, and Boxes: Double lock nuts and insulating bushings for rigid conduits in unclassified areas, NEMA 1. Hubs for rigid conduits in damp, wet, exterior, or corrosive areas, NEMA 12, 3R, 4, 4X. Bushings, insulating type, bell ends, or insulated throat fittings shall be installed on the ends of all conduits. Grounding type fittings and bushings shall be utilized as required for bonding.
2. Metallic Conduit Terminating in Non-Metallic Manholes or Pull Boxes: Insulated grounding bushing with lay-in ground lugs.
3. Flexible conduit for connection to movable equipment shall be liquidtight, utilizing listed liquidtight fittings.

M. Cleaning:

1. Clean and swab inside of conduits by mechanical means to remove foreign materials and moisture before conductors are installed.

N. Spare Conduits:

1. Install nylon pull line for future installation of cables. Cap all conduits and mark where end is located on Record Drawings with dimensions.

**END OF SECTION**

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**SECTION 26 05 32**  
**CONDUIT DUCTBANKS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish and install conduit ductbanks as required, and as shown on the Drawings. Materials employed shall be as indicated on the Drawings and specified herein. All exterior conduit shall be buried underground and embedded in sand as detailed. No splices are allowed underground due to high water table at the site.

**1.2 SUBMITTALS**

- A. Submit product literature including manufacturer part number, model number, material, size, and specifications. Material shall not be installed until the Engineer has reviewed the submittal data.
- B. Shop Drawings shall be submitted for review and acceptance showing routing, conduit size, and number and size of wires in each conduit before installation of conduit and any related work. Show proposed routing of conduits buried under floor slabs-on-grade, conduit and rebar embedded in floor slabs, columns, etc. Identify conduit by tag number of equipment served and by conduit schedule number.

**1.3 QUALITY ASSURANCE**

- A. MATERIAL MANUFACTURERS: Firms regularly engaged in manufacture of duct system components of type and sizes required, whose products have been in satisfactory use in similar service for not less than (3) years.
- B. STANDARDS: Comply with applicable portions of the NEMA standards pertaining to underground ducts. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components which have been UL listed and labeled. Comply with NEC requirements as applicable to construction of raceway systems.

**1.4 APPLICABLE SECTIONS**

- A. Section 31 23 15 - Excavation and Backfill for Pipelines.
- B. Section 26 05 00 - Electrical General Requirements.
- C. Section 26 05 19 – Conductors and Cables.

**PART 2 - PRODUCTS**

**2.1 DUCTS**

- A. Ducts shall be a single continuous length, round-bore, size as indicated, Nonmetallic Conduit, HDPE-40 or PVC SCH 40 with waterproof joints.
- B. Duct elbows, bends, and off-sets shall be per the manufacturer's requirements. Metal conduits underground are not allowed.

## **PART 3 - EXECUTION**

### **3.1 CONDUIT BANKS**

- A. Each ductbank shall be completely encased in sand. Thickness of sand over, under and around ductbank shall be not less than 3 inches as detailed. All ductbanks shall include a grounding electrode conductor as detailed.
- B. Unless noted otherwise, the top of the sand envelope shall be not less than 2'-6" below finished grade or paving.
- C. Ducts shall be installed to provide a water-tight, continuous length duct. If required, joints in duct shall be as per the manufacturer's requirements, and staggered at least 6 inches.
- D. Saddles shall be used for support as indicated on the drawings. Hold down anchors shall be provided as indicated.
- E. During construction, ends of ducts shall be plugged to prevent debris from entering into ducts. Particular care shall be taken to keep ducts clean of concrete or any other substance during the course of construction.
- F. After each duct line has been completed, a mandrel not less than 12 inches long, having a cross section approximately 1/2" less than the inside cross section of the duct, shall be pulled through to clean out the duct of earth, sand or gravel.
- G. Trenching, backfilling and surface repair shall be done in accordance with Division 2 of these specifications.
- H. Ductbanks shall be straight without bends or off-sets if at all possible.
- I. Over each ductbank at approximately 12 inches below grade, provide a detectable continuous red plastic warning tape to alert future excavators of the presence of the ductbank.
- J. Provide nylon pull line in all ducts.

**END OF SECTION**



**SECTION 26 05 34**  
**ELECTRICAL BOXES AND FITTINGS**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. Furnish and install electrical boxes and electrical fittings as required, and as shown on the Drawings. Materials employed shall be as indicated on the specified herein.
- B. Types of electrical boxes and fittings in this section include the following:
  - 1. Outlet boxes
  - 2. Junction boxes
  - 3. Pull boxes
  - 4. Conduit bodies
  - 5. Bushings
  - 6. Locknuts and hubs
  - 7. Knockout closures
  - 8. Miscellaneous boxes and fittings.

**1.2 SUBMITTALS**

- A. Submit product literature including manufacturer, model or part number, materials of construction, size, ratings, and listings as a minimum.

**1.3 QUALITY ASSURANCE**

- A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings.
- B. Comply with ANSI C 134.1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings, which have been UL listed and labeled.

**PART 2 - PRODUCTS**

**2.1 FABRICATED MATERIALS**

- A. Flush Interior Outlet or Device Boxes: Provide one piece, galvanized flat rolled sheet steel interior wiring boxes of types, shapes and sizes, including box depths, to suit each respective location and installation; construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box covers and wiring devices; minimum depth 1-1/2". Provide minimum 2-1/8" depth for boxes with three or more conduit entries.
- B. Interior Outlet or Device Box Accessories: Provide box accessories as required for each installation, including mounting brackets, hangers, extension or plaster rings, fixture studs, cable clamps and metal straps for supporting boxes, which are compatible with boxes being used and fulfilling requirements of individual wiring applications.

- C. Exposed Outlet or Device Boxes: Provide corrosion- resistant cast-metal type FD weatherproof wiring boxes of types, shapes and sizes (including depth) required, with integral threaded conduit hubs, face plates with spring-hinged waterproof caps suitable configured for each application, with face plate gaskets and corrosion-resistant fasteners.
- D. Junction and Pull Boxes: Provide junction and pull boxes with covers of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless hardware. Provide underground concrete junction boxes as required or indicated on the Drawings. Provide cast steel boxes with threaded hubs and gasketed cover as required or indicated on the Drawings.
- E. Conduit Bodies: Provide galvanized cast-metal Form 7 conduit bodies of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.
- F. Bushings, Knockout Closures, Locknuts, and Hubs: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and hubs, and conduit bushings and offset connectors of types, and sizes to suit respective uses and installation.
- G. All boxes, fittings, and conduit bodies shall be PVC coated wherever PVC coated conduits are required elsewhere in this specification.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:**

- A. General: Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
- B. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
- C. Provide cover plates for all boxes. See Section 26 05 22, Wiring Devices.
- D. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.
- E. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- F. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Install recessed boxes with face of box or ring flush with adjacent surface.
- G. Fasten boxes rigidly to substrates or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them.
- H. Provide electrical connections for installed boxes.

### **END OF SECTION**

**SECTION 26 05 74**  
**ELECTRICAL MOTORS**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. This section specifies alternating current induction motors 300 horsepower and less to be provided with the driven equipment. This section refers to motors by the enclosure type as defined in NEMA MG 1. Compliance by the supplier to the requirement of the specification does not relieve them of responsibility of furnishing motors and motor accessories that are suitable for the specified service conditions.

**1.2 QUALITY ASSURANCE**

A. General

1. Motors shall be built in accordance with UL 1004, NEMA Standard MG 1, and to the requirements specified herein.

B. References

1. This section references the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
FORM A-1 1	Motor Data Sheet
IEEE 85	Test Procedure for Airborne Sound Measurements on Rotating Machinery
NEMA ICS 6	Enclosure for Industrial Controls and Systems
NEMA MG 1	Motors and Generators
UL 1004	Motors, Electric
NEC	National Electric Code, Latest Edition

**1.3 SUBMITTAL DATA**

- A. Complete motor data shall be submitted with the driven machinery submittals. Motor data shall include.

1. Machine tag and loop number, as identified in the P&IDs, and specifications number of driven machine.
2. Motor manufacturer.
3. Motor Type or model and dimension drawing.
4. Nominal horsepower at installed altitude.
5. Nominal efficiency.
6. NEMA design.
7. Frame size.
8. Enclosure.
9. Winding insulation class and treatment.
10. Rated ambient temperature.
11. Service factor.
12. Voltage, phase, and frequency rating.
13. Full load current at rated horsepower for application voltage.

14. Starting code letter, or locked rotor KVA, or current.
  15. Special winding configuration such as part winding, star-delta.
  16. Rated full load speed.
  17. Power factor at full load.
  18. Power and connection requirements of motor winding heaters.
  19. Temperature protective device ratings and connection information.
  20. Recommended maximum size power factor correction capacitor.
  21. Motor insulation dielectric withstand rating.
  22. If driven from a variable frequency drive:
    - a. Certification that the motor meets the requirements of NEMA MG-1 1993 part 31.
    - b. Certification that the motor and mechanical drive are matched in design and suitable for use together for the specific installation and driven equipment conditions.
- B. The OWNER/CONTRACTOR shall complete the motor data sheet at the end of this Section for each and every motor supplied, and submit the completed forms to the ENGINEER for review, as part of the submittal package for each piece of equipment.
- C. Motor insulation resistance test report.

#### 1.4 SERVICE CONDITIONS

- A. Environmental Conditions
1. All motors are subject to hose directed spray and up to a temperature 40°C. Motors shall be totally enclosed unless otherwise specified and shall be rated for service at elevation 5,200 feet above mean sea level. Motors shall meet the criteria as specified in NEMA MG 1 for usual environmental conditions.
- B. Operating Conditions
1. Motors shall be selected for the operating conditions of the driven equipment in accordance with NEMA MG 1. Motors shall be subject to the vibration performance limits as follows:
    - a. The rotor shall be dynamically balanced according to NEMA Standards. Balance limits shall be 1/2 the limits shown on NEMA MG 1-12.06. The depositing of metal on the rotor (solder, weld, etc.) to achieve balance is not acceptable. Pavement metal is to be removed to achieve a balance only without effecting the structural strength of the rotor. Chiseling or sawing parent metal is prohibited. The addition of weights is acceptable.

#### 1.5 PERFORMANCE REQUIREMENTS

- A. Motors shall be continuous duty of the type generally described as having normal starting torque with low current, NEMA design "B".
- B. Starting current for fully loaded motors shall be as defined by NEMA design "B".
- C. Motors shall be sized for operation at their respective horsepower rating, never at their service factor rating. All motors shall be rated with a service factor of at least 1.15.

- D. The motor must develop sufficient locked rotor torque to provide breakaway of the load and to provide adequate torque during the acceleration period to overcome the load and inertial forces.
- E. Acceleration time must be short enough to be within the thermal limits of the motor, but not so short that it over stresses the driven equipment.
- F. Overhung load requirements such as the number and pitch radius of the motor-shaft-mounted pulley sprocket, etc., and the distance from the motor front bearing to the center of the pulley, sprocket, etc. must be determined and included in the purchase order.
- G. Motors are to be manufactured with multiple dips of Class H varnish in order to accommodate the application of adjustable speed drive systems voltage and severe duty environments.
- H. All equipment manufacturers shall provide a totally enclosed fan cooled motor, corrosion resistant and rated for severe, continuous duty operation.
- I. Motors shall operate successfully at rated load under the various combinations of voltage and frequency variations specified in section 12.44 of NEMA MG1-1998.
- J. Motors shall operate successfully under running conditions at rated load and frequency when the voltage unbalance at the motors terminals does not exceed 1%.
- K. Motor balance and vibration shall meet NEMA standards as defined in MG1-1998 part 7. The motor shall be dynamically balanced to meet 0.08 in/s maximum velocity at the bearing housing when measured in the horizontal, vertical and axial plane (0.12 in/s on 2-pole motors frame 280 and above).
- L. Unless otherwise specified in the equipment description, the motor rotation shall be possible in either direction – application permitting. See motor data sheet.

## 1.6 MOTOR CONSTRUCTION

- A. Mechanical and Electrical Features:
  - 1. All motors ¼ Hp through 2 Hp may have either NEMA C-Face or floor mounted feet, or both. Motors above 2 Hp shall be foot mounted in preference to any other method. Mounting requirements are provided in the horsepower descriptive section of the documents.
  - 2. All motors controlled by a variable speed drives shall be equipped with motor shaft ground rings.
  - 3. Long shaft motors are preferred over short shaft for close-coupled applications. Shafts shall have Impro seal supplied on both bearings. Motor shaft diameter shall comply with NEMA standard size for the motor frame size specified. Reduced, custom, or special shaft diameter motors are not acceptable unless specifically required by the application and approved, in writing, by project engineer. Notification of such variance must be submitted with bid proposals.
  - 4. Motor speeds are dictated in the equipment descriptive documents included with this specification.

5. The following NEMA frame size shall be provided unless specifically approved by the project engineer (3600, 1800, 1200 & 900 RPM):
  - a. 1 Hp through 2 Hp on a 143 T(C) to 213 T (C).
  - b. 3 Hp through 5 Hp on a 182 T(C) to 254 T (C).
  - c. 7.5 Hp through 10 Hp on a 213 T(C) to 284 TS
  - d. 15 Hp through 25 Hp on 254 T to 326TS
  - e. 30 Hp through 50 Hp on 286T to 404T
  - f. 60 Hp through 100 Hp on a 364 T to 445T
  - g. 125 Hp through 300 Hp on a 445TS to 5010 US
  - h. Above 200 Hp, frame selection shall be defined on equipment data and motor data sheets.
6. Stator frame, end brackets, fan cover and conduit box shall be manufactured of high 25 grade cast iron. All frames shall be designed and constructed such that on direct-coupled applications the motor can be mounted and aligned without distortion of the feet, and sufficient strength to withstand overhung loads for belt drive applications. The motor shall be designed with the capabilities for mounting the drive side vertically up or down as required by the application.
7. Ventilating fans shall be non-sparking bronze alloy or non-conductive nylon 66 materials. The ventilation shall be such that cool air is drawn in and hot air expelled to avoid mixing with the incoming air.
8. All motors 1 Hp to 250 Hp shall be rated and wired as 3 phase, 60 Hertz 460 volt operation. Exceptions to this requirement must be reviewed and authorized by the project engineer. If wired for 230/460 volt, a wiring diagram shall be illustrated on the inside of the conduit box or name plate.
9. Moisture inhibiting coating shall protect the rotor and stator. These coatings must match or exceed the anticipated full load thermal conditions, vibration, and shock electrical insulation ratings of the motor.
10. All cast iron motor parts shall be primed and painted with epoxy or polyester resin enamel or similar coatings for additional corrosion and moisture protection.
11. Motor stator and rotor steel shall be low-loss C-5 electrical grade silicon steel with interlamination insulation capable of withstanding a minimum of 1000 °F burnout. Stator random windings shall be copper and shall be insulated with class H insulation.
12. Bearings shall be either 300 series ball bearings or cylindrical roller bearings on the drive end and opposite drive end. Bearings shall be selected to provide a minimum L-10 life of 50,000 hours with an external load per NEMA MG 1-14 and a L-10 life of 100,000 hours in direct coupled applications. Bearing type shall be defined on the motor data sheet.
13. Bearings shall have a maximum of 45°C rise at rated horsepower (50 °C for 2-pole motors).
14. Bearings on frames 143T through 5010UZ shall be regreaseable with regreasing instructions labeled on the motors. The bearings found in frames 213T and larger shall have open bearings with cast iron inner bearing caps. If motor is to be operated by a variable frequency drive the manufacturer shall provide optional insulated bearings on both end of direct coupled motors. See motor data sheets for VFD motors.
15. The motor bearing housing shall have an extended automatic grease relief valve to effectively prevent bearings from being over-lubricated.
16. The motor nameplate shall have raised letters stamped on 304 stainless steel and be fastened to the motor frame with four stainless steel drive pins.

17. All motor hardware shall be English type and grade 5 zinc-dichromate plated.
18. The winding insulation system shall be Class H or better, non-hygroscopic, chemical, corrosion, fungus and humidity resistant. The complete insulation system will have a minimum resistance of 1.5 megohms after 168 hours of testing in a humidity chamber maintained at 100% relative humidity and 40° C ambient with both end bells removed. Motors used in adjustable speed drive applications shall have an insulation rating of 1860 vac peak with a 0.1 micro second rise time.
19. Motor leads shall be stranded copper, permanently identified on both ends and are brought out into the motor terminal box through a neoprene lead-positioning gasket with compression type terminal lugs. Each of the three leads shall be brought through a single hole into the conduit and termination box.
20. The conduit box shall be cast iron and threaded for rigid conduit connection. Conduit box shall be located at the F1 position of the motor unless otherwise noted on the motor data sheet. Conduit box volumes shall exceed the NEMA minimum standards by a minimum of 25% and boxes shall be able to rotate 90-degree increments. A bronze ground lug shall be provided in the conduit box.
21. A lifting eyebolt shall be provided for motor lifting (180 frame and larger). Eyebolt holes shall be threaded blind holes.
22. Motors shall be suitable for field configuration to any ceiling, wall, or floor mounting by rotating conduit box, end shield, and rotor – per application requirements (143T through 365T).
23. All motors shall meet the “NEMA Premium” efficiency requirements as outline by NEMA Table 12.12. Any deviation from this specification shall be received in writing from the project engineer.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Acceptable Manufacturers:
  1. General Electric Company.
  2. Louis Allis (Division of MagneTek, Inc.)
  3. U.S. Motors Corporation
  4. Toshiba.
  5. Reliance.
  6. Baldor Gold Series.
- B. The OWNER/CONTRACTOR shall assign to the designated equipment supplier the responsibility to select and supply suitable electric motors for the equipment. The choice of motor manufacturer shall be subject to review and acceptance by the ENGINEER. Such review will consider future availability of replacement parts and compatibility with driven equipment.

### **2.2 MOTORS LESS THAN ½ HORSEPOWER:**

- A. General

1. Unless otherwise specified, motors less than 1/2 horsepower shall be squirrel cage, single phase, and capacitor start induction run. Small fan motors may be split-phase or shaded pole type. Wound rotor or commutator type single phase motors are acceptable where its characteristics are necessary for the application. Conductors shall be copper.
- B. Rating
1. Motors shall be rated for operation at 115 volts, single phase, 60 Hz, and shall be continuous-time rated in conformance with NEMA Standard MG 1-10.35. Dual voltage rated motors are acceptable if all leads are brought out to the conduit box.
  2. Locked rotor current shall not be greater than specified in NEMA Standard MG1-10.36, Design "N".
- C. Enclosures
1. Unless otherwise specified, motors shall be totally enclosed.
- D. Bearings
1. Motors shall be provided with sleeve-type or sealed ball bearings lubricated for 5 years normal use.
- E. Insulation
2. Comply with NEMA 1-1.65.
  3. Motors shall be furnished with Class F insulation, rated to operate at a maximum ambient temperature of 40°C and at the altitude where the motors will be installed and operated, without exceeding temperature rise limits stated in NEMA MG 1-12.42 for a Class B insulation at ambient temperature of 40°C, and without using the service factor.

## 1.2 MOTORS 1/2 HORSEPOWER THROUGH 300 HORSEPOWER:

- A. General
1. The nominal motor horsepower shall be adequate for the driven machine without infringement upon the motor service factor at the installed altitude and specified ambient conditions.
  2. The motor horsepower shall be not more than the estimated maximum specified for each driven machine.
    - a. If the estimated maximum horsepower specified is not adequate to satisfy the foregoing restriction or any other requirements of these specifications, the motor with the next larger horsepower shall be supplied at no additional cost to the OWNER.
    - b. In addition, any changes caused by increase in motor horsepower shall be made by the OWNER/CONTRACTOR at no additional cost to the OWNER; such changes may involve circuit breakers, motor controllers, VFDs, motor and branch circuit and feeder conductors and conduit sizes, etc.
  3. Some requirements of the Section may be excluded for motors which are part of valve operators, submersible pumps, or motors which are an integral part of standard manufactured equipment (i.e., non-NEMA mounting, common shaft with driven element), to the extent that such variation reflects a necessary condition of motor service or a requirement of the specified driven equipment.



4. Motor Voltage Ratings: The OWNER/CONTRACTOR is required to review the Electrical Drawings and Specifications and to furnish all motors with voltage and phase as shown on the electrical drawings.
  - a. The OWNER/CONTRACTOR shall notify the ENGINEER of any discrepancy between any motor sizes indicated by the Drawings and specified elsewhere, and any requirements of the driven equipment and the availability of motors from the manufacturers listed above.
5. Special Requirements: The OWNER/CONTRACTOR shall refer to individual equipment specifications and the Drawings for special requirements such as motor part winding start, multi-speed windings, protective devices, auxiliary devices, etc.
6. High Efficiency Motors: Motors with a nameplate rating of 5 HP and above shall be "premium efficiency" units. Criteria stated herein, apply to horizontal motors without exception and apply to vertical motors insofar as they are available at time of construction.
  - a. Efficiency shall be determined by the test as set forth in IEEE 112, Method B.
  - b. If the inrush current due to the high efficiency design of the motor exceeds the available settings of the motor circuit protector, the motor circuit protector may be changed to a thermal magnetic circuit breaker, with the permission of the ENGINEER, at no additional cost to the OWNER.
    - 1) If is the OWNER/CONTRACTOR'S responsibility to perform the motor starting requirement coordination, and to notify the ENGINEER of any discrepancies.

B. Three Phase Motors

1. All motors 1/2 HP and larger shall be three phases unless otherwise indicated on Drawings, or specified elsewhere.
2. Voltage: All three phase motors shall be suitable for operation on 208, 230 and 460 VAC, unless otherwise indicated on the electrical plans.
3. NEMA Design:
  - a. Electric Motors shall be NEMA Design B, (except as noted in equipment specifications for motors controlled as variable speed operation and other special motors), constant speed squirrel-cage induction motors having normal starting torque with low starting current.
  - b. In no case shall starting torque or breakdown torque be less than the value specified in NEMA MG 1.
  - c. Starting kilovolt ampere per horsepower shall not exceed values as specified in NEMA MG-1-10.37.
  - d. Motors shall be suitable for operation on the following starting mechanisms as shown on the drawings:
    - 1) Across the line.
    - 2) Reduced voltage solid state starter.
    - 3) Variable frequency drive-inverter duty rated.
    - 4) 2 speed 2 winding.
4. Insulation:
  - a. Comply with NEMA 1-1.65.

- b. Motors shall be furnished with Class H insulation or with Class F insulation, rated to operate at a maximum ambient temperature of 40°C and at the altitudes where the motors will be installed and operated, without exceeding temperature rise limits stated in NEMA MG1-12.42 for Class B insulation at a 40° C ambient, and without using the service factor.
  - 5. Motor Bearings:
    - a. Antifriction, re-greaseable, and filled initially with grease suitable for ambient temperature to 40°C.
      - 1) Suitable for intended application and have AFBMA B-10 rating L-10 life of 60,000 hours or more.
      - 2) Bearing mounting shall be designed with easily accessible grease supply, flush, drain, and relief fittings using extension tubes where necessary.
- C. Vertical Motors
- 1. Comply with the requirements for three phase motors except where the following requirements are more stringent.
  - 2. Enclosure:
    - a. All vertical motors installed outdoors shall have Weather Protected Type II (WP II) enclosures.
    - b. All vertical motors installed indoors shall have Weather Protected Type I (WP I) enclosures.
  - 3. All vertical motors shall have a Service Factor of 1.15.
  - 4. Motor Bearings:
    - a. Antifriction, oil lubricated, and filled initially with oil suitable for ambient temperatures to 40° C.
      - 1) Suitable for intended application and have AFBMA B-10 rating life of 60,000 hours or more.
      - 2) Bearing mounting shall be designed with easily accessible oil supply, flush, drain, oil level gauge, and relief fittings using extension tubes where necessary.
    - b. Furnished with re-lubricate ball, spherical, roller, or plate type thrust bearings. Lubrication shall be per manufacturer's recommendation for smooth operation and long life of the bearings.

### 1.3 COMPONENTS

- A. Motor Enclosures:
  - 1. Open Drip Proof:
    - a. Stamped steel conduit boxes.
    - b. 1.15 service factor at 40° C ambient.
  - 2. Totally Enclosed Fan Cooled:
    - a. Cast iron conduit box.
    - b. 1.15 service factor at 40° C ambient
    - c. Tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller.
    - d. Automatic breather and drain devices for frames 324T and larger.
    - e. Upgraded insulation by minimum of 3 dips and bakes and sealer coat of epoxy or silicone.
  - 3. Severe Duty:

- a. Corrosion resistant type conforming to motors designated by manufacturer as:
  - 1) Chemical Duty.
  - 2) Mill and Chemical.
  - 3) Custom Sever Duty.
  - 4) Or similar applicable manufacturer's quality designation.
- b. 1.15 service factor at 40° C ambient.
- c. Tapped drain holes with Type 316 stainless steel plugs for frames 286T and smaller.
- d. Automatic breather and drain devices for frames 324T and larger.
- e. 2 cycles of vacuum epoxy impregnation of the motor windings.

#### 1.4 ACCESSORIES

##### A. Conduit Boxes

- 1. All vertical motors, shall have split-type cast metal conduit boxes.
- 2. Boxes on motors other than open drip-proof shall be gasketed.
- 1. Boxes shall be furnished with the size and number of openings as required for the conduits indicated on the Drawings.
- 2. Boxes shall be rotatable through 360 degrees in 90 degree increments.
- 3. Shall be furnished with an integral equipment ground lug installed and sized as required for the conductors indicated on the Drawings.

##### B. Lifting Devices: All motors weighing 265 lb (120 Kg) or more shall have suitable lifting devices for installation and removal.

##### C. Space Heaters:

- 1. All motors 1 HP and larger shall be furnished with winding heaters where installed outdoors.
- 2. Space heater ratings shall be 120 volts, single-phase, unless otherwise shown.
- 3. Bring power leads for heaters into conduit box.

##### D. Nameplate:

- 1. All motors shall be fitted with a permanent, stainless steel nameplate indelibly stamped or engraved with:
  - a. NEMA Standard motor data.
  - b. Bearing description and lubrication instructions.
  - c. Insulation class.
  - d. Ambient temperature.
  - e. Altitude rating.
  - f. Power factor at full load.

#### 1.5 CURRENT BALANCE

##### A. Current unbalance on polyphase motors shall not exceed the values tabulated below when motor is operating at any load within its service factor rating and is fed by a balanced voltage system:

- 1. Under 5 horsepower: 25 percent
- 2. 5 horsepower and above: 10 percent

#### 1.6 OVER-TEMPERATURE PROTECTION

A. General

1. Over-temperature protection devices shall provide a normally closed contact rated NEMA ICS Class B1 50. Relays or solid state contacts which are required shall be provided in an enclosure on or near the motor. Relay enclosure shall be in accordance with NEMA ICS-6 and shall be NEMA 4 for all motors.

B. Requirements

1. Over temperature protection is not required for motors rated less than 25 horsepower.
2. Over temperature protection for motors rated 25 horsepower or greater but less than 250 horsepower shall be thermal switches, NEMA MG 1-12.57, Type 2.
3. Over temperature protection for motors rated 250 horsepower or greater shall consist of a minimum of six 100 OHM Platinum RTD's embedded in the motor windings, and one 100 OHM for each bearing. Wiring to an external junction box shall be provided. Motor supplier shall coordinate with motor controller supplier to ensure RTD's match Multilin 369 requirements.

1.7 SHAFT CURRENT PROTECTION

- A. All motors coupled with a variable frequency drive (VFD) shall include a shaft grounding system. Acceptable systems include Mercotac Rotary Electrical Connectors, AEGIS SGR, or equal.

**PART 2 - EXECUTION**

2.1 TESTING

- A. Each motor shall be given a routine commercial test as required by NEMA MG 1 to demonstrate that it is free from electrical or mechanical defects. Copies of routine test reports shall be submitted in the format specified by NEMA.

**END OF SECTION**

**SECTION 26 09 13**  
**CONTROL DEVICES**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. This section sets forth the general specification and requirements for the control devices that shall be provided with control panels, motor starters, and other enclosures in order to assemble a complete and operable control, alarm, or indicating system.
- B. The SUPPLIER shall coordinate the installation of items specified herein as required to ensure the complete and proper interfacing of all the components and systems.

**1.2 APPLICABLE SECTIONS**

- A. The General Conditions, Supplementary General Conditions, Special Conditions, alternates and Addenda, applicable drawings and the technical specification herein shall apply to work under this Section.

**1.3 APPLICABLE REFERENCES**

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1985; Incl. Rev. 1 and 2; ICS-6) Enclosures for Electrical Equipment

NEMA ICS 1 (1988) General Standards for Industrial Controls and Systems

UNDERWRITERS LABORATORIES, Inc. (UL)

UL 50 Enclosures for Electrical Equipment

UL 508 Industrial Control Equipment

**1.4 SUBMITTALS**

- A. Provide complete submittal information for the control devices in accordance with Section 26 05 00.
- B. Comply with the following requirements:
  - 1. Submit certified dimensional drawings and manufacturer's data sheets for each size and type of device specified herein to be utilized. Data sheets are to be highlighted to define the specific materials of construction and features specified herein along with detailed manufacturer's model number.
  - 2. Submit instruction bulletins for each type of control device. The instruction bulletins shall include installation instructions, wiring diagrams, power requirements, maintenance instructions, calibration instructions, and any other details of a specialized nature to the devices furnished.

- C. Additional submittal requirements:
  - 1. Circuit Breakers and/or fuses:
    - a. Provide a complete schedule showing load and rating of circuit breakers and/or fuses.
  - 2. Control power transformers and/or power supplies:
    - a. Provide complete sizing calculations in accordance with the requirements identified herein.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Named manufacturers have been indicated for various specified devices to establish the standard of quality and performance of the equipment to be supplied.
- B. Devices of a given type shall be of the same model, class, or rating, have the same general appearance, and be from the same manufacturer.

### **2.2 GENERAL REQUIREMENTS**

- A. Analog measurements and control signals shall:
  - 1. Be electrical as indicated herein, and shall vary in direct linear proportion to the measured variable, except as noted.
  - 2. Electrical signals outside control panels shall be 4 to 20 mA DC, except as noted.
  - 3. Signals within enclosures may be 1 to 5 VDC, or 0-10 VDC.
  - 4. Dropping resistors shall be installed at all field side terminations in the control panels to ensure loop integrity.
- B. Control panels provided with integral power supplies and control power transformers shall be configured to match the voltage and current requirements of the loads.
- C. Each 120 VAC control loop or instrument shall have an individual circuit breaker or fuse within its respective control panel and clearly identified for function.
- D. Each PLC output shall have its own individual fuse external of the I/O card, with blown fused indication.
  - 1. Size external fuse to open before any I/O card mounted fuses.
- E. Signal isolators, Signal Converters, and Power Supplies:
  - 1. Signal isolators shall be furnished and installed in each measurement and control loop, wherever required:
    - a. To ensure adjacent component impedance match.
    - b. Where feedback paths may be generated.

- c. To maintain loop integrity when the removal of a component of a loop is required.
- 2. Signal converters shall be included where required to resolve any signal level or signal type incompatibilities.
- 3. Power supplies shall be included, as required by the device manufacturers' load characteristics, to ensure sufficient power to each loop component.

## 2.3 CONTROL DEVICES

### A. Signal Isolators and Converters.

- 1. Signal isolators shall have complete isolation of input, output and power input.
  - a. Signal input shall be 4-20 mA into 50 ohms, maximum.
  - b. Signal output shall be 4-20 mA into 1000 ohms, minimum.
  - c. Power input shall be 120 VAC, 60 Hz or 24 VDC.
  - d. Span and zero shall be adjustable.
  - e. Accuracy shall be  $\pm 1$  percent of span.
  - f. Units shall be surface or DIN rail mounted.
- 2. Signal Converters
  - a. Signal inputs of 1-5 V, 0-10 V, ect.
  - b. Signal output shall be 4-20 mA into 1000 ohms, minimum.
  - c. Power input shall be 120 VAC, 60 Hz or 24 VDC.
  - d. Span and zero shall be adjustable.
  - e. Accuracy shall be  $\pm 1$  percent of span.
  - f. Units shall be surface or DIN rail mounted.
- 3. Acceptable manufacturers:
  - a. Accromag.
  - b. AGM Electronics Model TA-4000.
  - c. Or approved equal.

### B. Relays

- 1. General Purpose Relays:
  - a. General purpose relays shall be plug-in type.
  - b. Contacts rated 10 amperes at 120 volts AC.
  - c. With LED indication when energized.
  - d. Quantity and type of contacts shall be as shown on the Plans or as needed for system compatibility.
  - e. Each relay shall be enclosed in a clear plastic heat and shock resistance dust cover.

- f. Sockets for relays shall have screw type terminals.
- g. Provide transient surge protection across the coil of each relay.
- h. Relays shall be:
  - 1) Potter and Brumfield Type KRP or KUP.
  - 2) IDEC.
  - 3) Square D Type K.
  - 4) Allen Bradley.
  - 5) Or approved equal.

2. Slave and Interposing Relays:

- a. Additional slave relays shall be provided when the number or type of contacts shown exceeds the contact capacity of the specified relays and timers.
- b. Additional relays shall be provided when higher contact rating is required in order to interface with starter circuits or other equipment.
- c. Shall be provided to compensate for voltage drop due to long wire runs.
- d. The slave and interposing relays shall be as the general purpose relays.
- e. Provide transient surge protection across the coil of each relay.

3. Time Delay Relays

- a. Time delay relays shall be pneumatic on-delay or off-delay type.
- b. Contacts shall be rated 10-amperes at 120 VAC.
- c. Units shall be including adjustable dial with graduated scale covering the time range in each case.
- d. Provide transient surge protection across the coil of each relay.
- e. As manufactured by Agastat, Series 7000.

C. Manual Operators and Interface Devices - Unclassified Areas

1. General Requirements

- a. NEMA Type 13 Oil tight.
- b. With synthetic rubber gasket.
- c. Heavy duty.
- d. Industrial grade full size 1 – 13/64" diameter.

2. Pushbutton Units:

- a. Contacts rated:
  - 1) NEMA A600.
  - 2) 600 VAC maximum.



- b. Color Code:
      - 1) Red - Stop
      - 2) Green - Start
      - 3) Orange - Open
      - 4) Blue - Closed
    - c. As manufactured by:
      - 1) Allen Bradley 800T.
      - 2) Square D Type K.
      - 3) Cutler-Hammer 10250T Series.
    - d. Furnish one spare normally open and normally closed contact with each switch.
  - 3. Selector Switches:
    - a. Contacts rated:
      - 1) NEMA A600.
      - 2) 600 VAC maximum.
    - b. As manufactured by:
      - 1) Allen Bradley 800T.
      - 2) Square D Type K.
      - 3) Cutler-Hammer 10250T Series.
    - c. Furnish one spare normally open and normally closed contact with each switch.
  - 4. Pilot Lights:
    - a. Transformer type LED pilot lights.
    - b. 120 VAC.
    - c. Push to Test type.
    - d. As manufactured by:
      - 1) Allen Bradley.
      - 2) Square D Type K.
      - 3) Cutler-Hammer 10250T Series.
- D. Manual Operators and Interface Devices - Corrosive Areas
  - 1. General Requirements:
    - a. NEMA 4X corrosion resistant.
    - b. Exterior parts to be made of high impact strength fiberglass reinforced polyester or other corrosion resistant materials.
    - c. Incorporating an internal neoprene boot which completely encloses all internal parts.

- d. Industrial grade full-size 1 – 13/64” diameter.
- 2. Pushbutton
  - a. Having an integral wiping gasket around the pushbutton that cleans the wall of the pushbutton guard of any foreign material accumulation as the button is operated.
  - b. Contacts rated:
    - 1) NEMA A600.
    - 2) 600 VAC maximum.
  - c. Color code:
    - 1) Red - Stop
    - 2) Green - Start
    - 3) Orange - Open
    - 4) Blue - Closed
  - d. As manufactured by:
    - 1) Allen Bradley NEMA 4, 4X – 800H.
    - 2) Crouse Hinds NPB1211.
    - 3) Cutler-Hammer E34 Series.
    - 4) Square D Type SK.
- 3. Selector Switches:
  - a. Contacts rated:
    - 1) NEMA A600.
    - 2) 600 VAC maximum.
  - b. As manufactured by:
    - 1) Allen Bradley NEMA 4, 4X-800H.
    - 2) Crouse Hinds NW 12221.
    - 3) Crouse Hinds NSW 12321.
    - 4) Cutler-Hammer E34 Series.
    - 5) Square D Type SK.
  - c. Furnish one spare normally open and normally closed contact with each switch.
- 4. Pilot lights:
  - a. Transformer type LED pilot lights.
  - b. 120 VAC.
  - c. Push to test.
  - d. Light colors shall be as identified on the Plans.

- e. As manufactured by:
  - 1) Allen Bradley NEMA 4, 4X-800H.
  - 2) Crouse Hinds NW 12221.
  - 3) Crouse Hinds NSW 12321.
  - 4) Cutler-Hammer E34 Series.
  - 5) Square D Type SK.

E. Terminal Blocks

- 1. Din rail mounted.
- 2. Terminal to be of the tubular screw type with pressure plate to minimize the possibility of breaking wire strands during tightening.
- 3. Recessed terminal hardware to minimize the possibility of contact with current carrying parts.
- 4. Molded of high dielectric material.
- 5. Minimum rating 600 VAC, 30 amp.
- 6. External connections to and from all control panel must be via terminal blocks, including power, control, alarm, instrumentation, monitoring, and solenoid circuits.
- 7. Individual terminals and terminal blocks shall be marked in a permanent manner with printed identification.
- 8. As manufactured by:
  - a. Entrelec M 4/6
  - b. Phoenix Contact UK 5 N
  - c. Or approved equal

F. Conductors within Control Panels

- 1. Single conductors shall be as follows:
  - a. Material: Soft annealed coated copper per ASTM B33 or B189.
  - b. Standard: ICEA S-19-81.
  - c. Stranded Wire - Class B.
  - d. Insulation and Coverings:
    - 1) Thickness: Per ICEA.
    - 2) Material:
      - a) No. 8 and Smaller: Type XHHW single conductor, copper power cable, moisture resistant, flame retardant thermoplastic insulation, 600 volt, 75 °C.
      - b) No. 6 and larger: Type XHHW-2 single conductor, copper power cable, heat and moisture resistant, flame retardant, thermoplastic insulation, 600 volt, 75°C.

- e. No. 14 AWG minimum, shall be used for field control circuits, unless otherwise noted.
  - f. No. 16 AWG minimum, Type MTW shall be used for all PLC I/O connections within the panel; between I/O device and field wiring terminal blocks.
2. Instrumentation Cable (Shielded Twisted Pair STP):
- a. Minimum conductor size 18 AWG.
  - b. Stranded and tinned copper conductors.
  - c. Polyethylene conductor insulated.
  - d. Foil aluminum-polyester shield – 100% shielding.
  - e. Minimum 18 AWG, stranded, tinned, copper drain wire.
  - f. PVC outer jacket.
  - g. UL Listed, TC rated.
  - h. 600 volt insulation level.

G. Wire markers:

- 1. Conductors within the control panel are to be permanently marked with wire numbers at each end.
- 2. Wire numbers are to correspond to the wire numbers indicated on the submittal drawings and are to correspond to the terminal block number to which they are attached in the control panel.
- 3. Markers shall be heat shrinkable tubing, imprinted type wire markers.
- 4. Manufacturers:
  - a. 3M.
  - b. Thomas & Betts.
  - c. Panduit.

H. Nameplates:

- 1. Nameplates: Engraved three-layer laminated plastic, white letters on black background.
- 2. Control components within the control panel shall have nameplates secured with stainless steel screws. Nameplates cannot be attached to the covers of the panel wireways.
- 3. The enclosure and components on the front cover or interior swing out panels shall be identified by nameplates.
  - a. Use standard manufacturer engraved nameplates for all pushbuttons, and selector switches only if color matches that specified for engraved nameplates. If not, then furnish nameplates to match colors as specified herein.
  - b. Use engraved plastic laminated nameplates for all other devices, displays, keypads, and annunciator LED's.

- c. For NEMA 12, 4, and 4X enclosures, use an epoxy based adhesive to affix nameplates to enclosure cover.
- 4. A nameplate shall be provided for each signal transducer, signal converter, signal isolator, power supply, relay, terminal strips, and the like mounted inside the panel. The nameplate nomenclature shall match the component names identified in the submittal drawings.
- 5. Lettering, styles, abbreviations and sizes shall be in conformance with ISA-RP-60.6 (1984) with an intended viewing distance of 3 to 6 feet for external nameplates and 1 to 2 feet for internal nameplates.
- I. Control Circuit Breakers:
  - 1. Each 120 VAC control circuit, instrument, or loop shall be powered from an individual control circuit breaker.
  - 2. Din rail mounted using the same DIN rail as used for the terminal blocks.
  - 3. Manual ON-OFF Switch.
  - 4. Rated 240 VAC.
  - 5. Rated 2000 AIC.
  - 6. Current ratings as needed load served.
  - 7. Provide complete nameplate identifying each circuit.
  - 8. As manufactured by:
    - a. ABB
    - b. Phoenix Contact
    - c. Entrelec
    - d. Square D
- J. Fused Terminals:
  - 1. Isolate all PLC Digital Outputs with fuses.
  - 2. Isolate all PLC Digital Inputs with fuses.
  - 3. Isolate all PLC Analog Inputs and Outputs with fuses.
  - 4. Coordinate fuse size to be as recommended by the manufacturers. For PLCs, the fuse size to be below internal output protection of the PLC output module.
  - 5. Fuses to be terminal block mounted.
  - 6. Furnish nameplate identifying each fused terminal.
  - 7. As manufactured by:
    - a. Entrelec
    - b. Phoenix Contact
    - c. Or approved equal
- K. Field / Remote Connections:

1. Field/remote connections shall be made at terminal blocks within the panel.
  2. Furnish an individual terminal block space for each wire.
    - a. Two wires on one terminal block will not be allowed.
  3. Furnish an empty wire channel on the backpanel adjacent to the field/remote terminal block strip to be used to route the field/remote wires to the connection terminal blocks.
  4. Provide spare terminal blocks as specified herein.
- L. Control Voltages:
1. Control voltage shall be supplied via control circuit breakers in the panel.
  2. Control power shall be sourced from the 120V power supplied to the panel, unless otherwise noted in the Plans.
  3. AC control voltages other than that supplied shall be transformed via a control power transformer within the panel. DC control voltages shall be supplied by AC to DC power supplies, specified herein.
- M. Control Power Transformers:
1. Low impedance type.
  2. The control power transformers shall have fused over current protection on both the primary and secondary sides of the transformer.
  3. Use actual coil power factors in calculating the VA rating of the transformer. Use a power factor of 35% if power factor of coils is unavailable.
  4. Determine the continuous VA rating of the transformer based on maximum sealed VA load current from the coils of the starters, relays, and pilot lights. Maximum inrush current shall be calculated based on the maximum inrush of devices that can be energized at one time plus the load presented by the devices already energized, and the actual power factor of the loads. This maximum inrush current must not cause the secondary voltage of the transformer to fall below 85% of rated voltage when the primary voltage has been reduced to 90% of rated voltage. Based on these calculations then actual transformer size shall be the calculated value times 1.5.
- N. Transient / Surge Protection
1. Data and Signal Line Protectors to be used on each and every analog input or output, and on each and every data and signal line external connection point:
    - a. Provide electronic circuits and components from damaging surge voltage and currents.
    - b. Provide protection of signal and data lines associated with computer, data, communications, instrumentation, broadcasting, and industrial control interfaces.
    - c. Shall be used directly with EIA standard interfaces:

- 1) RS-232
- 2) RS-422
- 3) RS-423
- 4) RS-485
- 5) 4-20 mA instrumentation loops.
- d. Repeatedly provide protection against surge currents in excess of 10,000 Amps.
- e. DIN rail mounted.
- f. Cable shields shall be passed through and may be either grounded or not grounded at the protector.
- g. System:
  - 1) Heavy duty multi-staged protectors.
  - 2) Solid state stage intercepts the leading edge of the surge with sub-nanosecond response time.
  - 3) Within micro-seconds, a 3-pole common chambered gas tube capable of handling 20,000 ampere lightning current operates and crowbars the surge to ground.
  - 4) The protector remains in the crowbar state until the surge has passed and line voltages return to safe levels.
- h. Location:
  - 1) Place at each end of a signal line, data line, or current loop.
  - 2) In the case of daisy chain configuration, such as RS-485, protectors shall be placed at each node.
- i. Electrical Characteristics:
  - 1) Surge Life:
    - a) Greater than 1000 operations with 200 Amps, 10 x 100  $\mu$ sec.
    - b) Greater than 10 operations with 10,000 Amps, 8 x 20  $\mu$ sec.
  - 2) Leakage current at rate line to ground voltage < 10  $\mu$ Amps.
  - 3) Signal/Data attenuation at maximum data rate 3 db with 600 terminations.
  - 4) Operating temperature -40°C to +60°C.
- j. As manufactured by:
  - 1) Joslyn:
    - a) For differential signals, such as RS-422 or RS-485, and current loops – Model 1820.

- b) For high frequency differential signals and current loops – Model 1821.
  - c) For line to ground protection, two separate circuits, and ground referenced signals (RS-232) and 4-20 mA loops where the return wire is grounded at the protector – Model 1810.
  - d) For high frequency line to ground protection, two separate circuits, and ground referenced signals (RS-232) and 4-20 mA loops where the return wire is grounded at the protector – Model 1811.
- 2. Protection from inductive spikes within the control panel.
  - a. Provide surge protection across all inductive coils for control relays, starters, solenoids, etc.
- O. Power Supplies: Power supplies shall convert 120 VAC  $\pm 10\%$  to 24 volt DC or other DC voltages as necessary.
  - 1. Power supplies shall have an excess rated capacity of 40 percent or be rated 100 watt minimum.
  - 2. The failure of a power supply shall be annunciated at the control panel and repeated to the SCADA system through a connection to PLC.
  - 3. Output regulation shall be accurate within  $\pm 0.05\%$  for a 10% line change or a 50% load change and shall include remote voltage sensing.
  - 4. The power supply shall be rated for temperatures of 32 to 122 degrees F and shall be UL recognized.
  - 5. Power supplies shall have fully isolated primary and secondary coils which shall be surrounded by an insulating enclosure which shall also provide mechanical isolation.
  - 6. All power supplies shall be designed and configured as fully redundant systems so that the failure of one power supply will automatically transfer to the other power supply with no interruption in power.
    - a. The power supply failure shall supply a dry contact for connection to a PLC input for an alarm indication.
  - 7. As manufactured by:
    - a. Power One W Series.
    - b. Phoenix Contact Quint Series.
    - c. IDEC Slim Line.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Conform to all application provisions of the NEMA and UL standards, NEC and local, state, and federal codes when fabricating the equipment.



- B. Install each item in accordance with manufacturer's recommendations and in accordance with the Contract Documents. Locate devices, including accessories, where they shall be accessible from grade, except as shown otherwise.
- C. Mount components in accordance with the installation details as prepared by the manufacturers.
- D. Mount equipment so that each device is rigidly supported, level and plumb, and in such a manner as to provide accessibility; protection from damage; isolation from heat, shock, and vibration; and freedom from interference with other equipment within the panel.
- E. Items, components, devices, and accessories shall be mounted and anchored using stainless-steel hardware, unless otherwise noted.

### 3.2 SPARES

- A. Unused inputs and outputs from the PLC shall be wired to field terminal blocks and identified.
- B. Furnish one spare normally open and one spare normally closed dry contact for each push-button, selector switch, relay, etc.
- C. Furnish ten spare fuses for each type of fuse in the panel.
- D. Furnish 15 spare terminal blocks or 20% whichever is greater.
- E. Furnish five spare relays for each type used in the panel.
- F. Spare contacts of relays, switches, etc., shall be internally wired to terminal blocks.

### **END OF SECTION**

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**SECTION 26 16 00**  
**PANELS AND CONSOLES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

- A. General: This section sets forth the general specifications and requirements for all the control panels and enclosures being provided under this contract.
1. Including but not limited to all:
    - a. All custom built and designed control panels.
  2. The CONTRACTOR shall furnish, supply and install all custom panels for this project in accordance Contract documents.
  3. This section also covers requirements for local control panels being supplied by the Equipment Manufacturers as part of the packaged equipment.
    - a. The CONTRACTOR shall design all interfaces between these control panels and the SCADA/PLC System.
  4. This specification covers the requirements for the fabrication of instrument panel boards or enclosures, mounting, finishing, piping and wiring of instrument equipment.
- B. Related Sections:
1. The Contract Documents are a single integrated document, and as such all Divisions and Section apply. It is the responsibility of the CONTRACTOR and its Sub-Contracts to review all sections to insure a complete and coordinated project.

**1.2 PANEL FABRICATION**

- A. The following paragraphs describe general fabrication requirements for the instrument panels, enclosures, and subpanels:
1. All internal instrument and component device wiring shall be as normally furnished by the manufacturer. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 C.
  2. Power distribution wiring on the line side of panel fuses shall be minimum 12 AWG. Secondary power distribution wiring and wiring for control circuits shall be minimum 14 AWG. Annunciator and indicating light circuits shall be minimum 16 AWG. Electronic analog circuits shall be 16 AWG twisted and shielded pairs rated not less than 300 volts. Analog circuits shall be separated from ac power circuits. Wiring for ac power distribution, dc power distribution, and control circuits shall have different colors and shall agree with the color coding legend on the system supplier's panel wiring diagrams.

3. The power entrance to each panel shall be provided with a surge protection device. Surge protectors shall be nominal 120 volts ac with a nominal clamping voltage of 200 volts. Surge protectors shall be a non-faulting and non-interrupting design with a response time of not more than 5 nanoseconds. Surge protectors shall be Transtector "ACP-I00BW", Power Integrity Corporation "ZTAS", or equal.
4. Terminal blocks for external connections shall be suitable for No. 12 AWG wire, and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labeled to agree with identification shown on the Supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits plus one ground for each shielded cable. All wiring shall be grouped or cabled and firmly supported to the panel. Not less than 8 inches of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space. Not less than 25 percent spare terminals shall be provided. Each control loop or system shall be individually fused, and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
5. The panel fabricator shall provide such additional circuits as may be indicated on the electrical schematic drawings.
6. Nameplates shall be provided on the face of the panel or on the individual device as required. Panel nameplates shall have approximate dimensions and legends as indicated on the drawings and shall be made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer. Nameplates shall be secured firmly to the panel.
7. All panels shall be thoroughly cleaned, sanded, and given not less than one coat of rust-inhibiting primer both inside and out. The panel interior shall be given not less than one coat of white enamel or lacquer. All pits and blemishes in the exterior surface shall be filled. Exterior surfaces shall be smoothed and given not less than two coats of enamel, polyurethane, or lacquer finish. Color samples shall be submitted to the Engineer for color selection. One quart of finish color paint shall be furnished with the panels to cover future scratches.

#### B. FACTORY TEST

1. Panels shall be factory-tested electrically and pneumatically by the panel fabricator in the presence of the ENGINEER before shipment.

### 1.3 SUBMITTALS

- A. Control Panel Engineering Submittals: Submit a two phase control panel engineering submittal for each and every control panel and enclosure being provided for this project.
  1. Phase I shall be the Control Panel Hardware submittal which shall include but not be limited to:
    - a. Enclosure construction details and NEMA type.
    - b. Finish, including color chart for ENGINEER selection of color.
    - c. Layout.

- d. Power circuits.
  - e. Signal and safety grounding circuits.
  - f. Fuses.
  - g. Circuit breakers.
  - h. Signal circuits.
  - i. Internally mounted instrumentation.
  - j. PLCs.
  - k. SCADA system components.
  - l. Face plate mounted instrumentation components.
  - m. Internal panel arrangements.
  - n. External panel arrangements.
  - o. Construction drawings drawn to scale which define and quantity.
    - 1) The type and gage of fabrication steel to be used for panel fabrication.
    - 2) The ASTM grade to be used for structural shapes and straps.
    - 3) Panel door locks and hinge mechanisms.
    - 4) Type bolts and bolt locations for section joining and anchoring.
    - 5) Details on the utilization of "UNISTRUT" and proposed locations.
    - 6) Stiffener materials and locations.
    - 7) Electrical terminal box and outlet locations.
    - 8) Electrical access locations.
    - 9) Print pocket locations.
    - 10) Writing board locations.
    - 11) Lifting lug material and locations.
  - p. Physical arrangement drawing drawn to scale which define and quantity the physical groupings comprising:
    - 1) Control panel sections.
    - 2) Auxiliary panels.
    - 3) Subpanels.
    - 4) Racks.
    - 5) Cutout locations with nameplate identifications shall be provided.
  - q. A bill of material which enumerates all devices associated with the control panel.
2. Phase II shall be the Control Panel Wiring Diagram submittal which shall include but not be limited to:

- a. Schematic/Elementary diagrams shall depict all control devices and circuits and their functions.
  - b. Wiring/Connection diagrams shall locate and identify:
    - 1) Electrical devices.
    - 2) Terminals.
    - 3) Interconnecting wiring.
    - 4) These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all electrical and control devices.
  - c. Interconnection diagrams shall locate and identify all external connections between the control panel/control panel devices and associated equipment.
    - 1) These diagrams shall show interconnecting wiring by lines, designate terminal assignments, and show the physical location of all panel ingress and egress points.
  - d. Control sequence diagrams shall be submitted to portray the contact positions or connections required to be made for each successive step of the control action.
3. All panel drawings shall be 22" x 34" reduced to and fully legible at 11" x 17", and submitted at 11" x 17" format size, with all data sheets and manufacturer specification sheets being 8.5" x 11".
  4. The submittal shall be in conformance with NEMA Standard ICS-1-1.01, and each phase shall be submitted as a singular complete bound volume or multi-volume package and shall have the following contents.
    - a. A complete index shall appear in front of each bound volume.
      - 1) All drawings and data sheets associated with a panel shall be grouped.
      - 2) All panel tagging and nameplate nomenclature shall be consistent with the requirements of the Contract Documents.
    - b. Completed ISA-S20 data sheets for all instrumentation devices associated with each control panel supplemented with manufacturer specification sheets which verify the products conformance to the requirements of the Contract Documents.
    - c. A listing of spare parts in conformance with each equipment specification section.

## 1.4 QUALITY ASSURANCE

### A. Environmental Suitability:

1. All indoor and outdoor control panels and instrument enclosures shall be suitable for operation in the ambient conditions associated with the locations designed in the Contract Documents.

2. Heating, cooling, and dehumidifying devices shall be provided in order to maintain all instrumentation devices to within a range equal to 20% above the minimum and 20% below the maximum of the rated environmental operating ranges.
  3. Provide all power wiring for these devices.
  4. Enclosures suitable for the environment shall be furnished.
  5. All instrumentation in hazardous areas shall be suitable for use in the particular hazardous or classified location in which it is to be installed.
- B. All control panels and assemblies shall be labeled and listed by a nationally recognized testing laboratory.
1. Underwriters Laboratory, Inc.
  2. Or equal.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. All panels are to be crated for shipment using a heavy framework and skids.
1. The panel sections shall further be cushioned satisfactorily to protect the finish of the instruments and panel during shipment.
  2. All equipment which is shipped with the panel shall further have suitable shipping stops and cushioning material installed in a manner to protect instrument parts which could be damaged due to mechanical shock during shipment.

## PART 2 - PRODUCTS

### 2.1 CONTROL PANELS

- A. The following paragraphs describe specific requirements for the control panels:
- B. CONSTRUCTION - NEMA 12 by Hoffman or equal in control room locations. NEMA 4X by Hoffman or equal in process or humid areas or outside.
1. NEMA 12
    - a. Seams continuously welded and ground smooth.
    - b. Door and body stiffeners as needed to make a rigid enclosure.
    - c. Heavy gauge continuous hinge.
    - d. Oil-resistant gasket attached to door with oil-resistant adhesive. Gasket to seal against roll lip on the enclosure opening.
    - e. Internal mounting panel held in place by collar studs welded to enclosure.
    - f. Lockable door latching and handle mechanism to allow easy access to interior of enclosure and keyboard.
    - g. Panel cut-outs for instruments, devices, and windows shall be cut, punched, or drilled and smoothly finished with rounded edges.
      - 1) Reinforce around cut-outs with steel angles or flat bars.
  2. Large panel cutouts such as for HMIs.

3. Pilot device groupings where the removed metal exceeds 50% of the available metal in an area bound by a 3" envelope around said pilot devices.
  - a. Finish.
    - 1) Interior, smooth, polyester power coating.
    - 2) Exterior polyester powder coating gray in color.
      - a) Panels that are in the same room as, motor control centers, switchboards, etc shall be of the same color as the motor control center or switchboards so that the control panel blends into the line up.
  - b. Manufacturer's standard gauge steel.
  - c. Each door to have a three-point latching mechanism and padlocking handle with rollers on the ends of the latch rods.
  - d. With heavy duty lifting eyes.
  - e. With flange mounted disconnect.
  - f. Mounting panel
    - 1) 10 gauge steel
    - 2) With stiffeners
4. Water tight corrosion resistant stainless steel
  - a. NEMA 4X in design, dust tight, water tight, and corrosion-resistant.
  - b. 14 gauge, Type 304 Stainless Steel.
  - c. Captive stainless steel cover screws threaded into sealed wells.
  - d. Oil resistant neoprene sealing gasket and adhesive to seal cover to enclosure.
  - e. Finish
    - 1) Cover surface and sides, unpainted, brushed finish.
  - f. Door fronts ground smooth.
  - g. Specifically designed for use with flange mounted disconnect switches.

- C. SIZE AND ARRANGEMENT - Panel dimensions and general instrument arrangement shall be as indicated on the drawings.
- D. Interconnecting wiring and wiring to terminals for external connection shall be MTW or SIS 16 AWG, stranded copper wire, insulated for not less than 600 volts, with a moisture-resistant and flame-retardant covering rated for not less than 90 degrees Celsius except for electronic circuits and special instrument interconnect wiring which shall be in accordance with manufacturer requirements. Provide a switched fluorescent light at every four feet of panel length.



E. PANEL WIRING:

1. Power distribution wiring on line side of panel fuses minimum 12 AWG.
2. Secondary power distribution wiring and wiring for control circuits: Minimum number 14 AWG.
3. Annunciator and indicating light circuits: Minimum 14 AWG.
4. Electronic analog circuits within instrument and control panels: Minimum 16 AWG twisted and shielded pairs or triads rated not less than 16 volts.
5. Provide a 15 amp, 120 volt GFCI service outlet within each panel.
6. Wire Insulation Colors:
  - a. Conductors supplying 120-volts AC power on the line side of a disconnecting switch shall have a black insulation for the ungrounded conductor.
  - b. Grounded circuit conductors shall have white insulation.
  - c. Insulation for ungrounded 120-volt AC control circuit conductors shall be red.
  - d. All wires energized by a voltage source external to the control panels shall have yellow insulation.
  - e. Insulation for all DC conductors shall be blue.
7. Wire Marking:
  - a. Each signal, control, alarm, and indicating circuit conductor connected to a given electrical point shall be designated by a single unique number which shall be shown on all shop drawings.
  - b. These numbers shall be marked on all conductors at every terminal in accordance with Section 26 05 09.
8. For case grounding, panels shall be furnished with a ¼-inch by 1-inch copper ground bus complete with solderless connectors for all equipment ground conductors.
  - a. Refer to Division 26 – Conduit Schedule for size and number of conductors.
9. Power Supply Wiring:
  - a. Each and every loop and instrument requiring 120 VAC shall be protected by individual DIN rail mounted circuit breakers.
    - 1) The number of circuits depends on the circuit load as noted herein.
    - 2) The circuit load shall not exceed 10 amp.
    - 3) Different panel section or different process units must not use common branch circuits.
    - 4) Furnish and install DIN rail mounted circuit breakers for all individual instruments.

- a) Circuit breakers shall be mounted on the back of the panel.
    - b) Identified by a service name tag.
  - b. Each potentiometer type instrument, electronic transducer, controller or analyzer shall have an individual DIN rail mounted circuit breaker located within the control panel.
    - 1) Circuit breakers shall have plastic tags indicating instrument tag numbers.
    - 2) Individual plug and cord set power supply connections require DIN rail mounted circuit breakers ahead of the receptacle.
- 10. Furnish circuit breakers for the panel lights, and for the panel receptacle.
- 11. Alarm Wiring:
  - a. Install and wire all alarms including light cabinets, audible signal units, test and acknowledge switches and remote logic units as specified.
  - b. Interconnecting wiring to panel mounted initiating devices shall also be wired.
  - c. Where plug and cord sets are provided for component interconnection, harness and support the cables in neat and orderly fashion. Where separate wire is required, install No. 16 AWG with MTW or TFFN insulation between all components.
- 12. Signal Wiring:
  - a. Signal Wire – Non Computer Use
    - 1) Signal wire shall be twisted pair or triads in conduit or troughs. Cable shall be constructed of No. 16 AWG with MTW or TFFN insulation between all components.
    - 2) Color code for instrument signal wiring shall be as follows:
      - a) Positive (+) – Black
      - b) Negative (-) – White.
    - 3) Multiconductor cables where specified shall consist of No. 18 AWG copper signal wires twisted in pairs, pairs, with 90°C, 600 V insulation.
      - a) A copper drain wire shall be provided for the bundle with a wrap of aluminum polyester shield. The overall bundle jacket shall be PVC.
    - 4) Use for connections between field terminal blocks and the PLC wiring arms for analog inputs and outputs.
  - b. Signal Wire – Computer Use

- 1) Signal wires shall be similar to those for non-computer use but each pair shall be triplexed with a copper drain wire and aluminum polyester tape shall be applied over the triplexed group.
  - 2) All cable shields, including thermocouple extension leads shall be terminated at a single point within the control panel.
  - 3) Continuity of the shield is to be maintained throughout the cable runs.
  - c. Multi-conductor cables, wireways and conduit shall be sized to allow for 20 percent signal wire.
13. Wiring Installation:
- a. All wires shall be run in plastic wireways.
  - b. Exception:
    - 1) Field wiring.
    - 2) Wiring run between mating blocks in adjacent sections.
    - 3) Wiring runs from components on a swing-out panel to components on a part of the fixed structure.
      - a) Wiring run from components on a swing-out or front panel to other components on a fixed panel shall be made up in tied bundles.
      - b) These bundles shall be tied with nylon wire ties, and shall be secured to panels at both sides of the "hinge loop" so that conductors are not strained at the terminals.
    - 4) Wiring run to front panel-mounted components.
  - c. Signal and low voltage wiring shall be run separately from power and 120 VAC control wiring.
    - 1) 120 VAC circuits shall be run through grey colored plastic wireways.
    - 2) 24 VDC circuits shall be run through white colored plastic wireways.
  - d. Wiring to rear terminals on panel-mount instruments shall be run in plastic wireways secured to horizontal brackets run above or below the instruments in about the same plane as the rear of the instruments.
  - e. Provide an empty wireway for all field wiring connections.
    - 1) 120 VAC circuits shall be run through grey colored plastic wireways.
    - 2) 24 VDC circuits shall be run through white colored plastic wireways.

- f. Conformance to the above wiring installation requirements shall be reflected by details shown on the shop drawings for the ENGINEER's review.
- 14. Grounding
  - a. Furnish equipment ground bus with lugs for connection of all equipment grounding wires.
- F. ANALOG CIRCUITS AND AC POWER CIRCUITS: Separated.
- G. INTERNAL PANEL WIRING COLORS:
  - a. AC Power Distribution: Red
  - b. DC Power and Control: Blue
  - c. Instrument: Black and white twisted shielded pair.
  - d. Other and in agreement with manufacturer's wiring diagrams as stated on manufactured drawing legend.
- H. SURGE PROTECTION DEVICE FOR POWER ENTRANCES: Nominal 120 volts AC with a nominal clamping voltage of 200 volts; nonfaulting and noninterrupting design with a response time of not more than 5 nano-seconds. Utilize a branch panel TVSS unit as described in Section 26 35 53.
- I. TERMINAL BLOCKS FOR EXTERNAL CONNECTIONS: Suitable for specified AWG wire, rated 30 amperes at not less than 600 volts (for incoming power circuits, and for field 1/0 terminals they shall be Phoenix contact or equal as shown on the drawings); with marking strip, covers, pressure connectors, and labeled terminals, each conductor of external circuits plus one ground terminal for each shielded cable. Provide minimum 25 percent spare terminals.
- J. Group cables, and firmly support wiring to the panel. Provide minimum 8 inches clearance between terminal strips and the base of vertical panels for conduit and wiring space. Individually fuse each control loop or system, and clearly label and locate fuses or circuit breakers for maintenance.
- K. Furnish and install equipment grounding conductor in accordance with NEC 250. Provide power ground lugs. Provide signal insulated and isolated ground lugs.
- L. Nameplates on Internal and External Instruments and Devices: Materials approximate dimensions with legends as indicated on the Drawings made of laminated phenolic material having engraved letters approximately 3/16 inch high extending through the black face into the white layer; firmly secured to panels.
- M. POWER SUPPLIES/FUSING
  - 1. Design and arrange regulated 24 volt DC power supplies for instrument loops so that loss of 1 loop does not affect more than one instrument loop or system. Provide power supplies suitable for an input voltage variation of plus or minus 10 percent. Fuse or short circuit protects the supply output.

2. Selectively fuse the power distribution from multi-loop supplies so that a fault in one instrument loop will be isolated from the other loops being fed from the same supply. Label and locate fuses for easy access.
3. Output Voltage Regulation: As required by the instrument or control equipment being supplied.
4. Backup power supply units shall be provided to automatically supply the load upon failure of the primary supply. Design backup supply systems so that either the primary or backup supply can be removed, repaired, and returned to service without disrupting the instrument system operation.
5. Oversize the multi-loop supply systems for an additional 25 percent future load. Indicate failure of a multi-loop supply on the respective instrument panel or enclosure.
6. Furnish and install signal repeaters for instrument loops that exceed the load impedance of the power supplies. Indicating fuses: Neon bulb type for 120 VAC circuit and glass indicating fuse type for 24 VDC circuits.

N. SOURCE QUALITY CONTROL:

1. Functionally factory test instrument and control panel items electrically and pneumatically before shipment.

O. PANEL ACCESSORIES:

1. Manufacturers: Weidmuller SAKS; Entrelec; Phoenix Contact; Wago; or equal.
  - a. Terminal Blocks: Nickel plated copper only; DIN rail; universal foot with the following as required for the application.
    - 1) Universal type
    - 2) Feed through
    - 3) Ground
    - 4) Neutral disconnect
    - 5) Intrinsically safe
    - 6) Explosion-proof
    - 7) Fuse
    - 8) Knife disconnect
    - 9) Ground fault indicator
    - 10) Bolt connecting
  - b. Terminal Block Labeling: Each terminal and each conductor as previously specified with machine labels only.
    - 1) Manufacturers: Phoenix Contact; Entrelec; or equal.
      - a) Signal Interface Modules:
        1. Analog isolating converter

2. Ground loop isolations
  3. Signal amplification
  4. Signal level matching
  5. 24 VDC power supply (120 VAC input)
2. Disconnect Switches:
  - a. Switches shall consist of a thermal magnetic circuit breaker with integral door operator – lockable
    - 1) Minimum 22 KAIC
    - 2) Not required for panels fed with 120 VAC or less. A nameplate must be furnished on the cover of the control panel identifying all sources of supply and foreign voltages within the control panel.
  - b. The main disconnect shall disconnect all power sources within the control panel.
  - c. Sized in accordance with the NEC and total connected horsepower and associated locked rotor currents.
  - d. A disconnect shall be provided for each motor controller/starter within the control panel. This disconnecting means shall disconnect power and control power to each motor controller. Each disconnect shall be equipped with a dead front operator through either the cabinet door or a dead front panel.

### **PART 3 - EXECUTION – (NOT USED)**

#### **END OF SECTION**

**SECTION 26 20 00**  
**SERVICE AND DISTRIBUTION SYSTEMS**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. Provide all operations, methods, labor and equipment and provide and install all materials and incidentals necessary for the completion of the work as specified herein or included on the Drawings.

**1.2 WORK INCLUDED**

- A. Electrical work required is indicated on the Drawings and specified herein and elsewhere includes, but is not necessarily limited to:
  - 1. Complete electrical distribution systems for power, control, and instrumentation as shown.
  - 2. Complete system of raceways, conductors, and equipment for all other auxiliary systems required. If noted, the equipment and wiring of these auxiliary systems will be furnished and installed under their respective sections; however, the conduit or raceway systems will be furnished and installed in accordance with Division 26 05 00.
- B. The CONTRACTOR shall furnish and install all component parts of all the systems required for their safe and proper operation, whether or not specifically mentioned or noted on the Drawings, except those items or articles which are specifically noted as being supplied otherwise.
- C. Perform all trenching and backfilling required in connection with the work which shall be in strict accordance with the provisions of Division 31 of these specifications.
- D. Provide all required electrical conduits, conductors, and connections to items described in all other sections of these specifications.

**1.3 APPLICABLE SECTIONS**

- A. The General Conditions, Supplementary Conditions, Special Conditions, Alternates and addenda, applicable drawings and the technical specifications herein shall apply.
- B. Section 26 24 17 – Distribution Panelboards.

**1.4 ELECTRICAL SERVICE**

- A. New underground electrical service(s) from the local utility shall be at 480/277 volt, three phase, four wire, 60 hertz AC with current ratings as indicated on the Drawings.
- B. The CONTRACTOR shall install service conduits and conductors from the utility transformer location to the service entrance section. The installation shall be in accordance with the utility company's published requirements. The CONTRACTOR shall coordinate the installation with the utility.

## **PART 2 - PRODUCTS – (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Installation of the service entrance sections shall be in accordance with the manufacture's requirements.

### **3.2 INSTALLATION OF GROUNDING ELECTRODE SYSTEM**

- A. The service entrance section shall be bonded to the grounding electrode system (GES). The GES consists of, but not limited to, the metal underground water pipes, metal frame of the building or structure, concrete encased electrode (UREF), ground rings, rods, pipe, or plate electrodes, and other metal underground systems or structures as in compliance with the NEC. Provide bonding jumper same size as system ground to provide ground continuity from customer's side of metallic lines service entrance and street side of metallic mains. The neutral (grounded conductor) and grounding electrode system shall be connected together at the service disconnect only.
- B. The UFER ground system consists of a bare copper conductor, size as indicated in the Drawings, concrete encased 2" above the bottom of the foundation footing of the building or structure which is in direct contact with earth. The UFER ground will make a complete loop in the foundation and is bonded to the rebar steel at least in two locations. UFER ground connections shall be exothermic welds.
- C. The equipment grounding system shall be such that all metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, portable equipment and other conductive items in close proximity with the electrical circuits operate continuously at ground potential and provide a low impedance path for the possible ground fault currents. The system shall comply with the National Electrical Code, modified as indicated on the Drawings or specifications.
- D. The distributions system shall be provided with a separate equipment grounding conductor for each single or three-phase feeder, each branch circuit, each motor circuit, control or instrument raceways as indicated. The grounding conductor shall be installed in the common raceway with the related phase and/or neutral conductors. Flexible conduit equipment connections utilized in conjunction with branch circuits or feeders shall be provided with suitable bonding jumpers connected to listed grounding type fittings when required.

### **3.3 TESTING**

- A. General: Upon completion of this portion of the work, test all parts of the electrical system in the presence of the ENGINEER.
- B. Test Requirements: All systems shall test free from short circuits and grounds, shall be free from mechanical and electrical defects, and shall show an insulation resistance between phase conductors and ground of not less than that required by the manufacturers.



### 3.4 FINAL INSPECTION

- A. The CONTRACTOR shall be present at the final acceptance of the work by the OWNER.
- B. The CONTRACTOR shall have pad and pencil to list all deficient items noted. Corrections and adjustments of deficient items shall be done after the inspection, not during.
- C. See Section 26 05 00 for other requirements for final acceptance.

**END OF SECTION**

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**SECTION 26 22 00**  
**DRY TYPE TRANSFORMERS**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. This Section consists of dry type transformers and related items necessary to complete the work indicated within the Contract Documents.

**1.2 REFERENCES**

- A. NEMA ST 1 – Specialty Transformers (Except General – Purpose Type).
- B. NEMA ST 20 – Dry Type Transformers for General Applications.
- C. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (International Electrical Testing Association).
- D. NFPA 70 – National Electrical Code.
- E. UL – Underwriters Laboratories, Inc.

**1.3 SUBMITTALS**

- A. In accordance with Section 26 05 00.
- B. Product Data: provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type and rated temperature rise.

**1.4 DELIVERY, STORAGE, AND HANDLING**

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

**PART 2 - PRODUCTS**

**2.1 DRY TYPE TRANSFORMERS**

- A. Transformers shall be premium high efficiency quiet type with copper windings, and shall be installed where indicated on the Drawings. The primary winding of the transformers shall have two 2-1/2 percent taps above, and below normal.
- B. The transformers shall have a BIL of 10 KV with a temperature class of 185 degrees C for transformers up to 25 KVA, and a temperature class of 220 degrees C for larger transformers.
- C. The sound level shall not exceed 44 dBA measured at 5 feet from the transformer after installation. Core and coil assemblies 30 KVA and larger, shall be mounted on rubber vibration isolators, designed to reduce harmonics generated noise.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Set transformer plumb and level.
- B. Use flexible conduit, 2 feet minimum length for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
- D. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.
- E. Mount trapeze-mounted transformers as indicated.
- F. Provide grounding and bonding in accordance with Section 26 05 26.

### **3.2 FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.2.

### **3.3 ADJUSTING**

- A. Adjusting installed work.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

## **END OF SECTION**

**SECTION 26 24 16**  
**BRANCH CIRCUIT PANELBOARD**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Lighting and Appliance Panelboard - Furnish and install lighting and appliance panelboard(s) as specified herein and where shown on the associated schedules drawings.

**1.2 REFERENCES**

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

- A. NEMA PB 1 – Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
- E. UL 50 - Enclosures for Electrical Equipment
- F. UL 67 – Panelboards
- G. UL 98 - Enclosed and Dead-front Switches
- H. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- I. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
- J. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
- K. Federal Specification W-P-115C - Type I Class 1
- L. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
- M. NFPA 70 - National Electrical Code (NEC)
- N. ASTM - American Society of Testing Materials

**1.3 SUBMITTAL AND RECORD DOCUMENTATION**

- A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

**1.4 QUALIFICATIONS**

- A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.
  - B. Panelboards shall be manufactured in accordance with standards listed.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Inspect and report concealed damage to carrier within their required time period.
  - B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
  - C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.
- 1.6 OPERATIONS AND MAINTENANCE MATERIALS
- A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
  - B. Refer to Sections 26 05 00 and 26 05 05 for additional requirements.
- 1.7 WARRANTY
- A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.
- 1.8 RELATED WORK
- A. Section 26 35 53 – Transient Voltage Surge Suppression

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Square D Company Type NF - Class 1670.
- B. Cutler Hammer.
- C. General Electric.

### **2.2 LIGHTING AND APPLIANCE PANELBOARD TYPE**

- A. Fabrication:
  - 1. Interior
    - a. Continuous current ratings, as indicated on Drawings, not to exceed 600 amperes maximum for main breaker panelboards and not to exceed 800 amperes for main lug panelboards.
    - b. Minimum Short Circuit Rating: as indicated on the Drawings.
    - c. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors limited to bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise

tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be plated copper. Bussing rated for 600 and 800 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.

- d. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
- e. A solidly bonded copper equipment ground bar shall be provided.
- f. Split solid neutral shall be plated and located in the mains compartment up to 250 amperes so all incoming neutral cable may be of the same length.
- g. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.
- h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
- i. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 125A interiors shall be vertically mounted. Main circuit breakers over 125A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.
- j. Interior phase bus shall be pre-drilled to accommodate field installable options. (i.e., Sub-Feed Lugs, Sub-Feed Breakers, Thru-Feed Lugs)
- k. Interiors shall accept 125 ampere breakers in group mounted branch construction.

## 2. Main Circuit Breaker

- a. Shall be bolt-on type circuit breakers.
- b. Main circuit breakers shall have an over center, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true RMS sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.
- c. Two and three pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall

have a single magnetic trip adjustment located on the front of the breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.

- d. Circuit breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.
- e. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
- f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.
- g. The circuit breakers shall be UL Listed for use with the following accessories: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.

### 3. Branch Circuit Breakers

- a. Shall be Square D type circuit breakers. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the panelboard schedules drawings.
- b. Molded case branch circuit breakers shall have bolt-on type bus connectors.
- c. Circuit breakers shall have an over center toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
- d. There shall be two forms of visible trip indication. The circuit breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.
- e. The exposed faceplates of all branch circuit breakers shall be flush with one another.
- f. Lugs shall be UL Listed to accept solid or stranded copper conductors only. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16.
- g. Breakers shall be UL Listed for use with the following factory installed accessories: Shunt Trip, Auxiliary Switch, and Alarm



Switch.

- h. Breaker shall be UL Listed with the following ratings: (15-125A) Heating, Air Conditioning, and Refrigeration (HACR), (15-30A) High Intensity Discharge (HID), and (15-20A) Switch Duty (SWD)

4. Enclosures

a. Type 1 Boxes

- 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
- 2) Boxes shall have removable end walls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
- 3) Box width shall not exceed 26" wide.

b. Type 1 Fronts

- 1) Front shall meet strength and rigidity requirements per UL 50 standards. Shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
- 2) Fronts shall be hinged 1-piece with door. Mounting shall be surface as indicated on associated drawings. All covers shall be hinged cover type.
- 3) Panelboards rated 250 amperes and below shall have MONO-FLAT fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated above 250 amperes shall have vented fronts with concealed door hinges. Doors on front shall have rounded corners; edges shall be free of burrs.
- 4) Front shall have flat latch type lock with catch and spring loaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

c. Type 4, and 12

- 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
- 2) All doors shall be hinged cover type. All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59 inches or more in height. All lock assemblies shall be

keyed alike. One (1) key shall be provided with each lock. A clear plastic directory card holder shall be mounted on the inside of door.

- 3) Maximum enclosure dimensions shall not exceed 21" wide and 9.5" deep.

5. Surge Protective Device

- a. Integral Surge Suppressor shall be provided for each branch circuit panelboard. See Section 26 35 53 for requirements.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

### **3.2 FIELD QUALITY CONTROL**

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

### **3.3 INSTALLATION OF PANELS**

- A. Installation: Unless otherwise indicated on the drawings, install wall panels with the top of the trim 6'-0" above the finished floor. Panels located in equipment rooms and wire closets shall be surface mounted. Floor mounted panels shall be provided with a 4" concrete housekeeping pad. Floor mounted panels shall be anchored to floor at all four corners and to wall or structural member at top for seismic restraint.
- B. Directories: Mount a typewritten directory behind glass or plastic on the inside of each panel door. On the directory, show the circuit number and complete description of all outlets with specific locations on each circuit. In addition, provide a typewritten label inside door showing source of power to panel to feeder switch, panel designation and location within buildings.

## **END OF SECTION**

**SECTION 26 24 17**  
**DISTRIBUTION PANELBOARD**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Power Distribution Panelboard - Furnish and install distribution panelboard(s) as specified herein and where shown on the associated schedules and drawings.

**1.2 REFERENCES**

The panelboard(s) and circuit breaker(s) referenced herein are designed and manufactured according to the latest revision of the following specifications.

- A. NEMA PB 1 – Panelboards
- B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- C. NEMA AB 1 - Molded Case Circuit Breakers
- D. UL 50 - Enclosures for Electrical Equipment
- E. UL 67 – Panelboards
- F. UL 489 - Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- G. CSA Standard C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards
- H. CSA Standard C22.2 No. 5-M91 - Molded Case Circuit Breakers
- I. Federal Specification W-P-115C - Type I Class 1
- J. Federal Specification W-C-375B/Gen - Circuit Breakers, Molded Case, Branch Circuit And Service.
- K. Federal Specification W-C-865C - Fusible Switches
- L. NFPA 70 - National Electrical Code (NEC)
- M. ASTM - American Society of Testing Materials

**1.3 SUBMITTAL AND RECORD DOCUMENTATION**

- A. Approval documents shall include drawings. Drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

**1.4 QUALIFICATIONS**

- A. Company specializing in manufacturing of panelboard products with a minimum of fifty (50) years documented experience.
- B. Panelboards shall be manufactured in accordance with standards listed Article 1.2 - REFERENCES.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Inspect and report concealed damage to carrier within their required time period.
- B. Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- C. Store in a clean, dry environment.  
Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

## **1.6 OPERATIONS AND MAINTENANCE MATERIALS**

- A. Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- B. Refer to Sections 26 05 00 and 26 05 05 for additional requirements.

## **1.7 WARRANTY**

- A. Manufacturer shall warrant specified equipment free from defects in materials and workmanship for the lesser of one (1) year from the date of installation or eighteen (18) months from the date of purchase.

# **PART 2 - PRODUCTS**

## **2.1 MANUFACTURERS**

- A. Square D Company.
- B. Cutler Hammer / Eaton.
- C. Or Equal.

## **2.2 POWER DISTRIBUTION PANELBOARDS**

- A. Circuit Breaker Distribution Panelboard
  - 1. Interior
    - a. Shall be rated 600 Vac or 250 Vdc maximum. Continuous main current ratings as indicated on associated schedules and drawings not to exceed 1200 amperes maximum. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67.
    - b. Provide UL Listed short circuit current ratings (SCCR) as indicated on the associated drawings not to exceed the lowest interrupting capacity rating of any circuit breaker installed with a maximum of 200,000 RMS symmetrical amperes. Main lug and main breaker panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
    - c. The panelboard interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.

- d. The bussing shall be fully rated with sequentially phased branch distribution. Panelboard bussing rated 100 through 600 amperes shall be plated copper. Bussing rated 800 amperes and above shall be plated copper. Bus bar plating shall run the entire length of the bus bar. The entire interleaved assembly shall be contained between two (2) U-shaped steel channels, permanently secured to a galvanized steel mounting pan by fasteners.
  - e. Interior trim shall be of dead-front construction to shield user from all energized parts. Main circuit breakers through 800 amperes shall be vertically mounted. Main circuit breaker and main lug interiors shall be field convertible for top or bottom incoming feed.
  - f. A solidly bonded copper equipment ground bar shall be provided.
  - g. Solid neutral shall be equipped with a full capacity bonding strap for service entrance applications. As scheduled, UL Listed panelboards with 200% rated solid neutrals shall have plated copper neutral bus for non-linear load applications. Gutter-mounted neutral will not be acceptable.
  - h. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label, and Short Circuit Current Rating shall be displayed on the interior or in a booklet format. Leveling provisions shall be provided for flush mounted applications.
2. Group mounted circuit breakers through 1200A
- a. Circuit breaker(s) shall be group mounted plug-on with mechanical restraint on a common pan or rail assembly.
  - b. The interior shall have three flat bus bars stacked and aligned vertically with glass reinforced polyester insulators laminated between phases. The molded polyester insulators shall support and provide phase isolation to the entire length of bus.
  - c. Circuit breakers equipped with line terminal jaws shall not require additional external mounting hardware. Circuit breakers shall be held in mounted position by a self-contained bracket secured to the mounting pan by fasteners. Circuit breakers of different frame sizes shall be capable of being mounted across from each other.
  - d. Line-side circuit breaker connections are to be jaw type.
  - e. All unused spaces provided, unless otherwise specified, shall be fully equipped for future devices, including all appropriate connectors and mounting hardware.
3. Electronic trip molded case 100% rated circuit breakers.
- a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup, Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.

- b. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13<sup>th</sup>) harmonic. Sensor ampere ratings shall be as indicated on the associated schedule and drawing.
  - c. Local visual trip indication for overload, short circuit and ground fault trip occurrences.
  - d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
  - e. Communications capabilities for remote monitoring of circuit breaker trip system, to include phase and ground fault currents, pre-trip alarm indication, switch settings, and trip history information shall be provided.
  - f. Circuit breaker shall be provided with Zone selective Interlocking (ZSI) communications capabilities on the short-time and ground fault functions compatible with all other electronic trip circuit breakers and external ground fault sensing systems as noted on schedules and drawings.
  - g. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.
- 4. Electronic trip molded case standard function 80% rated circuit breakers.
  - a. All electronic circuit breakers shall have the following time/current response adjustments: Long Time Pickup, Long Time Delay, Short Time Pickup, Short Time Delay, Ground Fault Pickup Ground Fault Delay and Instantaneous settings. Each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments.
  - b. Circuit breaker trip system shall be a microprocessor-based true RMS sensing designed with sensing accuracy through the thirteenth (13<sup>th</sup>) harmonic. Sensor ampere ratings shall be as indicated on the associated schedule and drawing.
  - c. Local visual trip indication for overload, short circuit and ground fault trip occurrences
  - d. Long Time Pickup indication to signal when loading approaches or exceeds the adjustable ampere rating of the circuit breaker shall be provided.
  - e. Furnish thermal magnetic molded case circuit breakers for 250A frames and below.
- 5. Thermal magnetic molded case circuit breakers
  - a. Molded case circuit breakers shall have integral thermal and instantaneous magnetic trip in each pole.
  - b. Ampere ratings shall be as shown on the Drawings.
- 6. Enclosures

- a. Type 1 Boxes
    - 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Zinc-coated galvanized steel will not be acceptable.
    - 2) Boxes shall have removable blank end walls and interior mounting studs. Interior support bracket shall be provided for ease of interior installation.
    - 3) Maximum enclosure dimensions shall be 44" wide and 9.5" deep.
  - b. Type 1 Trim Fronts
    - 1) Trim front steel shall meet strength and rigidity requirements per UL 50 standards. Shall have an ANSI 49 medium gray enamel electrodeposited over cleaned phosphatized steel.
    - 2) Trim front shall be 4-piece with door available in surface mount. Trim front door shall have rounded corners and edges free of burrs. A clear plastic directory cardholder shall be mounted on the inside of the door.
    - 3) Locks shall be cylindrical tumbler type with larger enclosures requiring sliding vault locks with 3-point latching. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.
  - c. Type 4, and 12
    - 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
    - 2) All doors shall be gasketed and be equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners. A clear plastic directory cardholder shall be mounted on the inside of door. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock.
    - 3) Maximum enclosure dimensions shall not exceed 44" wide and 14.5" deep.
7. Surge Protection Devices: Provide surge suppression equipment (TVSS) for each panelboard and service entrance panelboards. See Section 26 35 53.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and NEC standards.

### 3.2 FIELD QUALITY CONTROL

- A. Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20% of each other. Maintain proper phasing for multi-wire branch circuits.
- C. Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

**END OF SECTION**



**SECTION 26 26 00**  
**TERMINAL BLOCKS**

**PART 1 - GENERAL**

1.1 SCOPE OF WORK:

- A. This section covers terminal blocks for control and other wiring.

1.2 SUBMITTALS:

- A. Products shall be submitted in accordance with Section 26 05 00, and elsewhere in the Contract Documents, prior to installation.

1.3 MANUFACTURERS:

- A. Terminal blocks shall be Entrelec, Phoenix Contact, Weidmuller, or equal.
- B. Surge protection blocks shall be MTL Surge Technologies, Series SD, or equal.
- C. Power distribution blocks shall be Ilsco Corporation, or equal.

**PART 2 - PRODUCTS**

2.1 TERMINAL BLOCKS:

- A. Terminal blocks shall mount on standard DIN rail, and be of the size required for conductors therein. A minimum of 25 percent spares shall be provided in each terminal box. No more than 2 conductors shall be allowed per termination. Jumper bar assemblies shall be installed for interconnecting terminal blocks, distributing power and signal commons. Terminal blocks shall be U.L. rated for 600 Volts, and 30 Amps, minimum.
- B. Grounding terminal blocks shall be provided for instrumentation cable shields. The terminal blocks shall have distinctive 2-color bodies, and shall be mounted to the DIN rail with metal screw down type clamps, providing a positive ground connection. One grounding terminal block shall be installed for every 2 instrument cables terminated. Grounding terminal blocks shall be U.L. rated for 600 Volts, and 20 Amps, minimum.
- C. Terminal blocks shall be available in a variety of colors, including red, green, blue, gray, black, yellow, and orange.
- D. DIN mount fuse holders shall have blown fuse indicators for EC and AC circuits. Fuse holders shall be of the compression clamp type. Fuse holders shall be U.L. listed, and rated for 600 Volts. Fuse sizes shall not exceed the U.L. current rating for the fuse holders.
- E. DIN rail shall be prepunched, zinc bichromate plated steel. Symmetrical DIN rail shall be 35 mmX7.5mm, minimum.
- F. Terminal blocks for 4 to 20 milliamp signals shall have knife disconnect switches, and accessible test points for testing and measurement of current loop signals, without the need for removing wire terminations.

## 2.2 SURGE PROTECTION BLOCKS (SPB):

- A. Analog inputs and outputs shall be terminated at surge protection blocks (SPB). He SPBs shall be designed for a working voltage of 32 volts, and shall be fused.
- B. SPBs shall provide full hybrid line to line protection, and shall have a GDT rating of 10,000 A (8/20us pulse waveform).
- C. SPBs shall be UL94 V-2 listed.

## 2.3 POWER DISTRIBUTION BLOCKS (PDB):

- A. PDBs shall be Electro-tin plated and manufactured from high strength 6061-T6 aluminum alloy.
- B. PDBs shall be UL Recognized rated 90° and CSA Certified.
- C. PDBs shall provide flexibility in using the connector as an in line splice or to reduce conductor size.
- D. PDBs shall be rated for 600 Volts and dual rated for Copper and Aluminum Conductor.
- E. PDBs shall have the sizes and ratings per NEC.

## PART 3 - EXECUTION

### 3.1 INSTALLATION:

- A. Each terminal block and fuse holder shall be identified with the circuit number, or conductor number, corresponding to the identification appearing on the shop Drawings for the equipment, or system.
- B. Terminal block and fuse holder markers shall be computer printed plastic-type, with permanent markings.
- C. End clamps and end sections shall be installed on each terminal block and fuse holder assembly.
- D. Terminal blocks for DC voltages shall be blue, and AC voltages shall be gray.

### END OF SECTION

**SECTION 26 28 13**  
**FUSES**

**PART 1 - GENERAL**

**1.1 SCOPE**

- A. Furnish all labor, materials, equipment, appliances, and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
- B. Fuses.
- C. Spare Fuse Cabinet.

**1.2 APPLICABLE SECTIONS**

- A. The General Conditions, Supplementary General Conditions, Special Conditions, Alternates and Addenda, applicable drawings and the technical specifications including but not limited to the following:
  - 1. Section 26 05 00 - Electrical General Requirements
  - 2. Section 26 05 19 – Conductors and Cables

**1.3 ACCEPTABLE MANUFACTURERS**

- A. Manufacturer: Bussmann.
- B. Other acceptable manufacturers: Gould Shawmut, Little Fuse.
- C. All fuses shall be of one manufacturer. Fuses shall have a 200,000 ampere RMS symmetrical interrupting rating unless noted otherwise.

**PART 2 - PRODUCTS**

**2.1 FUSE TYPES AND RATINGS**

- A. Fuses from 0 to 600 ampere for each circuit serving a single motor shall be UL Class RK5 dual-element Low Peak, LPN-RK (250 volt), LPS-RK (600 Volt).
- B. All other fuses in the 0 to 600 ampere range shall be UL Class RK5, dual-element, time delay, low peak, LPN-RK (250 volt), LPS-RK (600 Volt).
- C. Fuses larger than 600 ampere shall be UL Class L with time delay, Hi Cap, KRP-C.
- D. High voltage fuses - see drawings.

**PART 3 - EXECUTION**

**3.1 INSTALLATION**

- A. Motor circuits shall be fused. Fuses, 0 to 600 amperes, for 1.15 service factor motors shall be sized not exceeding 125% of motor full load amperes shown on nameplate. Fuses, 0 to 600 amperes, for all other motors shall be sized not exceeding 115% of motor full load amperes. Fuses above 600 amperes for all motors shall be sized up to 150% of motor full load amperes. Abnormal motor starting conditions requiring

- over sizing shall be coordinated with motor manufacturer.
- B. Spare fuses shall be furnished for all fuse types. Spares shall amount to 10% of installed fuses with a minimum of one set of each fuse type and ampere rating. The set shall equal the number of poles in the appropriate switch.
  - C. Provide Spare Fuse Cabinet equal to Bussmann for storing spare fuses. Mount on wall in Equipment Room as directed by the ENGINEER.

**END OF SECTION**

**SECTION 26 28 19**  
**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.1 SUMMARY**

**A. Includes But Not Limited To**

1. Furnish and install disconnects as described in Contract Documents, except those provided integral with equipment.

**B. Related Sections**

1. Section 26 05 00 - Electrical General Requirements
2. Section 26 05 09 - Electrical Identification
3. Section 26 28 13 – Fuses

**1.2 SUBMITTALS**

- A. Submit product literature including manufacturer part number, model number, material, size, ratings, and specifications.**

- B. Refer to Section 26 05 00 for submittal requirements.**

**PART 2 - PRODUCTS**

**2.1 MATERIALS**

**A. Manufacturer**

1. 1. Same MANUFACTURER as Motor Control Centers.

**B. Disconnect Switches:**

1. Heavy duty quick-make, quick-break type, fused, unless indicated otherwise.  
Provide a control switch for VFD fed motors which will disengage the VFD prior to opening the switch.
2. Provide interlock to prevent opening of door when switch is in ON position.
3. Provide means to lock switch in OFF position with padlock.
4. Disconnects for motor circuits shall be horsepower rated.
5. Where indicated on Drawings for small motors, disconnects shall be manual starter with thermal overload relay.
  - a. Device shall have one pole per ungrounded conductor of motor.
  - b. Provide overload relay to match motor full load amps.
  - c. Equip with lockout device.
6. Enclosures:

- a. Interior Dry locations - NEMA Type 12, or as indicated or required.
  - b. Exterior, Damp, or Wet Locations - NEMA Type 4X Stainless steel, or as indicated or required.
7. Fuses:
- a. Fuse fused disconnects with dual-element time delay fuses and equip with rejection type fuse holders.
  - b. Fuses on shall be from single manufacturer.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Label disconnects to indicate equipment served, such as Condensing Unit CU-1. Use 1/16 inch (1.6 mm) thick laminated plastic composition material with contrasting color core. Engraved letter shall be 1/4 (6 mm) inch high. Attach labels with screws.

**END OF SECTION**

**SECTION 26 29 23**  
**PULSE WIDTH MODULATED VARIABLE FREQUENCY DRIVES**

**PART 1 - GENERAL**

**1.1 SCOPE OF WORK**

- A. Provide all labor, materials, equipment and incidentals required and install, place in operation and field test variable frequency drive.
- B. The adjustable frequency controller shall be a flux vector sine-wave, pulse width modulated (PWM) design. A modulation method which incorporates "gear changing" is not acceptable. The final responsibility of the completed drive system is that of the manufacturer. Qualified system integration will be by manufacturers approved and should use methods and procedures approval in writing by the VFD manufacturer prior to shipping the drive system to customer site. One manufacturer shall provide all drives systems under this contract. The drive systems shall be manufactured within the United State of America to alleviate concerns of future spare part availability and technical support. All drive systems shall be purchased and furnished by the CONTRACTOR.
- C. Drives for motors shall include an active front end filter to obtain the required harmonics mitigation. If a passive filter must be used, under no circumstances shall it introduce a leading power factor at any speed / loading of the motor.

**1.2 QUALITY ASSURANCE STANDARDS**

- A. The entire VFD system as described herein shall be assembled and factory tested to assure a properly coordinated system.
- B. Codes: Provide equipment is full accordance with the latest applicable rules, regulations, and standards of:
  - 1. Local Laws and Ordinances.
  - 2. State and Federal Laws.
  - 3. National Electrical Code (NEC).
  - 4. Underwriters Laboratories (UL).
  - 5. American National Standards Institute (ANSI).
  - 6. National Electrical Manufactures Association (NEMA).
  - 7. Institute of Electrical and Electronic Engineers (IEEE).
- C. The complete drive system shall be UL listed.
- D. The manufacturer will have a minimum of 12 years experience in Integrated Bi-polar Transistor technology.

### 1.3 ACCEPTABLE EQUIPMENT MANUFACTURERS

- A. Allen Bradley
- B. Square D, Altivar Process 630
- C. General Electric
- D. WEG
- E. Galt

### 1.4 SUBMITTALS

- A. Submittals shall conform in all respect to this section.
- B. Submittals shall be prepared specifically for this project by the VFD manufacturer. For this specific application submittal package will be due three weeks upon request.
- C. Submittal information shall include, but not be limited to:
  - 1. Equipment dimensions, including stub-up locations, shipping split and shipping weights.
  - 2. Approval electrical drawings, termination drawings and component location diagrams.
  - 3. Manufactures equipment specification.
  - 4. Catalog cut sheets of major components.
  - 5. Spare parts list, per Paragraph 3.03.
  - 6. Certifications, including:
    - a. Warranty, per section 1.04
    - b. Efficiencies, per section 2.02. A.1.
    - c. Harmonic distortion analysis study, per section 2.01E.

### 1.5 WARRANTY

- A. All equipment furnished under this section shall be warranted for all parts and labor by the CONTRACTOR and the original equipment manufacturer for a period of not less than one (1) year from the date of startup.
- B. The manufacturer shall meet the quality and program requirements of ISO 9001.

## **PART 2 - PRODUCTS**

### 2.1 MATERIALS AND EQUIPMENT



- A. Any modification to the standard product required to meet this specification shall be performed by the VFD manufacturer or approved systems integrator only. Distributors and panel manufactures changes to the VFD products are specifically disallowed.
- B. The VFD system shall consist of harmonic filter unit, converter section, output inverter and control logic. All components shall be wired and tested together as a complete system. The labor and materials for field interconnection of the system are to be provided by the VFD manufacturer. Each drive shall be designed for stand alone operation. Multiple drive units shall not utilize shared components. The drive shall be housed in a free standing, front accessible, general purpose indoor enclosure rated NEMA 1, gasketed, with fans and filters. Cabinets shall be single or multi-bay, sheet steel with hinged doors. Doors will have concealed hinges with lockable through-the-door handle operator mechanism. Provisions shall be made for top or bottom entry/exit of incoming line power cables, outgoing load cables and control wiring. All VFD's shall include DC link reactors.
- C. Each VFD shall have a molded case, circuit breaker type main power disconnect switch, with an external operating handle. The circuit breaker and the drive unit shall have a minimum short circuit rating symmetrical interrupting capacity at least as high as the panel/MCC feeding it and shall be labeled in accordance with UL Standard 489.
- D. The following safety features shall be standard on all drives:
  - 1. Provisions to padlock main disconnect handle in the "OFF" position.
  - 2. Mechanical interlock to prevent opening cabinet door with disconnects in the "ON" position, or moving disconnect to the "ON" position while the unit door is open.
  - 3. Auxiliary contact on main disconnects to isolate control when fed from external source.
  - 4. Barriers and warning signs on terminals that are energized with the power disconnect "OFF".
- E. Any VFD over 60 horsepower shall meet all requirements as outlined in the latest adopted edition of IEEE 519 for each individual and total harmonic voltage and current distortion and as indicated in this specification. As per the latest adopted IEEE 519, individual or simultaneous operation of the VFD's shall not add more than 3% total voltage harmonic distortion while operating at full load and speed from the utility source, or more than 5% while operating from a standby generator (if applicable).
  - 1. The VFD manufacturer cannot predict or be responsible for pre-existing voltage distortion on the line or distribution from sources supplied by others. Maximum input voltage unbalance shall be .5% as defined in NEMA MG1 section 14.35.2.
  - 2. As per IEEE 519, maximum allowable total harmonic current demand distortion limits for each VFD operation at full load and speed shall not exceed 5% as calculated and measured at the point of common coupling ( $I_{sc}/I > 20$ ).
  - 3. The point of common coupling for all harmonic calculation and field measurement for both voltage and current distortion shall be defined as the main bus feeding each drive.

4. The short circuit current used for harmonic calculations shall be defined as the total full load current with all VFD's operating multiplied by twenty. Example (5) 100 HP VFD's Full load current = 5 x 126 amps = 630 amps. Short circuit current = 20x 630 amps = 12600 amps.
  5. If harmonic filters are required to meet these requirements, the VFD manufacturer must provide as a minimum 5<sup>th</sup>, 7<sup>th</sup>, and 11<sup>th</sup> harmonics filters and is responsible for the design and manufacturing of the filters. The vendor must supply cabling and installation for the filters. The filters are to be provided with a separate contactor such that the VFD can operate in the event of a filter failure. Failure of a filter shall not cause the entire drive system to shutdown.
- F. Harmonic compliance shall be verified with onsite field measurement of both the voltage and current harmonic distortion on the main bus of the VFD termination without the VFD in operation. A recording of harmonic analysis displaying individual and total harmonic currents and voltage must be utilized.
- G. VFD system shall maintain a 95 minimum true power factor throughout the entire speed range.
- H. Displacement power factor shall be .95 percent or higher throughout the entire operating speed range, measured at drive input terminals.
- I. Motors over 60HP-249HP shall include thermal switch shutdown. For motors over 250hp, the drive shall include an RTD monitoring module which shall monitor 8 – 100 ohm platinum RTD's in the motor.
- J. Variable Frequency Drive Ratings:
1. The minimum drive efficiency for NEMA 1 enclosed drive shall be 95.0 percent or better at motor base speed and rated torque. Losses shall include all control power and cooling system losses associated with the drive as well as the input phase shifting transformer.
  2. Input Power rating shall be 400-460VAC, plus 10 percent, minus 10 percent, 3 phase, 60 Hz, plus 2, minus 2 Hertz.
  3. The voltage ride through of the VFD shall be capable of sustaining continued operation with a 40% dip in normal line voltage. Output speed may decline only if current limit rating of VFD is exceeded.
  4. Power loss ride through of the VFD shall be capable of a minimum of 3 cycles loss.
  5. The output power shall be HP, 460 Volt, 3 Phase, 60 Hertz, per motor nameplate FLA at installed altitude plus service factor of 25%.
  6. The operating ambient Temperature -10 to 40°C (14 to 104°F).
  7. The storage temperature shall be -20 to 60°C (4 to 140°F).
  8. The relative operating humidity shall be 0 to 95% Non-Condensing.
  9. The site operating vibration condition shall be acceleration at 0.6 G maximum (10-55 Hz). Amplitude at 0.1mm maximum (50-100 Hz).
  10. Drives shall be sized/de-rated to operate at full load at the project elevation.

11. Power unit rating bases shall be 100% rated current continuous and 120% for one minute at rated temperature.

## 2.2 CONSTRUCTION

- A. The controller shall produce an adjustable AC voltage / frequency output. It shall have an output voltage regulation to maintain correct output V/Hz ratio despite incoming voltage variations.
- B. The controller shall have a continuous output current rating of 100% of the motor nameplate rating as a minimum.
- C. The converter section will incorporate three distinct diode bridges configured in a series connection. The series connection will provide continued balance of the bridges to insure the harmonic distortion remains consistent throughout the life of the drive. The input to the diode bridges will be a full phase shifting isolation transformer with multiple secondaries. The variable frequency drive system shall also include a filter network and a transistorized inverter section. The drive manufacturer will also manufacture the Transistors used in the inverter section of the drive to reduce harmonics to flow back to the incoming power source.
- D. The inverter output shall be generated by to be Insulated Gate Bipolar Transistors (IGBT's) with a PIV rating of 1200 volts minimum. The VFD shall not induce excessive power losses in the motor. The worst case RMS motor lines current measured at rated speed, torque and voltage shall not exceed 1.05 times the rated RMS motor current for a pure sin wave operation.
- E. The controller (s) shall be suitable for operating standard NEMA Design-B induction squirrel-cage motor having a 1.15 service factor. The drive can be located up to 300 feet from the motor without requiring special cabling or a separate motor protection devices. Motor nameplate information shall be provided by the CONTRACTOR, prior to contract award to the VFD manufacture to properly size the inverter. In the future, it shall be possible to substitute any standard inverter-rated motor (equivalent horse power, voltage and RPM) in the field. Output filters shall be installed for motors over 300 foot from VFD.
- F. The control logic section shall be fully digital and not require analog adjustment pots or fixed selector resistors. A power failure will not necessitate a reload of any drive parameter or configuration.

## 2.3 BASIC FEATURES

- A. The door of each adjustable speed drive system shall include an operator interface station and key pad with a manual speed device. The interface shall be LED and have a minimum of 4 – digit, 7 – segment display. Each drive shall have a “Local”, “Remote”, “Manual” / “Auto”, “Power On”, “VFD Running” & “VFD Fault” indicating light or LED signal display. Included in the operator interface shall be a manual start, stop, bypass and fault reset button on the key pad or face of the panel.

- B. The VFD shall include a customer selectable automatic restart feature. When enabled the control pad of the VFD it shall automatically attempt to auto restart after a trip condition resulting from over current, over voltage, over load, loss of utility power or out of saturation. It shall be programmable with up to 10 retries. For safety the drive will require manual restart for other customer programmable faults. The fault displays shall include over current, over voltage, heat sink overheat, load side short circuit, load-side ground fault, inverter overload, stator over-current during start-up, load-side over current during start-up, EEPROM error, RAM error, ROM error, communication error, (Dynamic braking resistor over current), Emergency Stop, Under voltage, low current, over torque, lose of phase, and motor overload.
- C. The door mounted key pad interface shall be capable of controlling the VFD and setting the drive parameters. The key pad shall have the following programming features:
  - 1. The digital display must present all diagnostic messages and parameters values in English engineering units when accessed.
  - 2. The digital interface keypad shall allow the operator to enter exact numerical settings in engineering units. A plain English user menu (rather than codes) shall be provided in software in nonvolatile memory as a guide to parameter setting and reset table in the field through the key pad. The drive set up parameters must be able to be transferred to new boards to reprogram spare boards.
  - 3. The VFD shall have the capabilities of communicating via communications protocols to the PLC. All status shall be communicated to the PLC including 3 phase voltage, 3 phase current, speed, status alarms, errors, etc.
  - 4. Three programmable output relay contacts shall be rated for 250 VAC, 2 Amps. A separate 24 VDC power supply (50 mA) shall be available for control exterior control devices. Two programmable analog output signals shall be available to meet system requirements.
  - 5. The principle output frequency shall be programmable from 0-400 Hz and acceleration / deceleration from .1 to 6000 seconds. The PWM carrier frequency shall be adjustable from .5 to 15 kHz and shall be self adjusting.
  - 6. The VFD shall have internal to the drive a proportional gain; integral gain anti-hunting gain, lag time constant and PID error limit adjustments. This shall be programmable through the key pad.

## 2.4 ENCLOSURE

- A. All VFD components shall be factory mounted and wired on a dead front, grounded indoor NEMA Type 1, gasketed enclosure. It shall be suitable for mounting on a concrete house keeping pad. The steel enclosure shall have a minimum of two-layer of primer and one-layer of industrial finished Sherwin Williams Precision enamel paint.
- B. A forced air cooling system will automatically start and stop as necessary to extend the life of the fan.
- C. VFD systems shall be stand alone system with an integral through the door mounted disconnect switch operator.

## 2.5 PROTECTIVE FEATURES AND CIRCUITS

- A. The VFD shall have the following additional protective features that will protect against damage to the motor, load conductor, contactors or solid state soft starts and the VFD internal devices and electronics.
- B. Three phase short circuit on the VFD output terminals.
- C. Losses of input power due to opening VFD input disconnect device or loss of utility power during VFD operation.
- D. A loss of one (1) phase of the input power shall cause the drive to trip off protecting the drive systems electronics.
- E. The VFD will run without connection to the motor load.
- F. The VFD shall sense an output short circuit that may occur during operation.
- G. The key pad display shall provide a minimum of the last 50 system faults.
- H. There shall be stall protection on an overload condition with inverse time overcurrent trip. Current limits shall be adjustable from 10 to 215% of the drive current.

## 2.6 PARAMETER SETTINGS

- A. The following system configuring setting shall be provided and field adjustable, without exception, through the keypad/display unit. Except for motor nameplate data, all parameters must be adjustable while the processor is on-line and the drive is running.
  - 1. Motor Nameplate Data.
  - 2. Motor Full Load Amps.
  - 3. Motor Frequency.
  - 4. Number of poles.
  - 5. Full Load RPM's.
  - 6. Motor Voltage.
  - 7. Operating current limits. – Min/Max.
  - 8. VFD Configuration Parameters.
  - 9. Independent accel/decel rates.
  - 10. Min./Max. speed (Frequency
  - 11. Forward or Reverse operation.
  - 12. Catch a spinning load selection.
  - 13. Preset Speed capabilities.
  - 14. Volts per Hertz ratio.
  - 15. No load / Full Load boost.
  - 16. Over current trip selection.

17. Frequency jump selection.
  18. Programmable meter output signals (Hz. Speed, RPM, Voltage, Torque, PID feed back, input/output power, and DC bus voltage).
- B. Automatic Control
1. 4-20 mA input control signal.
  2. PID internal or external set point capabilities.
  3. Programmable preset speed operational run conditions.
  4. Automatic load reduction during overload condition or soft stall.
  5. Programmable loss of signal control: Stop, maintain speed or default to preset speed or set point.
- C. All drive setting adjustable and operation parameters shall be restored in a parameter log which allows minimum and maximum points as well as the present set values. This parameter log shall be accessible via a RS-232 or RS485 serial port as well on the keypad or internal to the drive.
- D. The drive shall have the following inputs/output features that will provide control and monitoring of the VFD. The analog outputs shall be isolated as required by this specification.
1. Three programmable analog outputs.
  2. Two programmable analog inputs. The 4-20mA analog input speed reference signal will be galvanically isolated. Calibration adjustments shall be provided by the keypad.
  3. 4-groups of 8 pattern runs or 32 pattern runs shall be available.
  4. Three programmable digital output (form C, dry contact relays)
  5. One potential pot input (three wire control) +10 V, wiper and common.
  6. System control program providing built-in drive control or application specific configuration capabilities.
  7. One system E-stop input (dry contact) coast to stop.
  8. Input / output function shall match those indicated in the drawings.
  9. Minimum / maximum dry contact output.

## 2.7 DIAGNOSTIC FEATURES AND FAULT HANDLING

- A. The VFD shall include a comprehensive microprocessor based digital diagnostic system that monitors its own control functions and displays faults and operating conditions.
- B. A "Fault Log" shall be accessible through the keypad digital illustrations in English. The display shall be capable of illustrating 50 past faults. Optional output shall be through the serial port link. All drive possible fault conditions will be accessible through the fault log.

## 2.8 DRIVE OPTIONS

- A. For drives located more than 300 feet from motor, the drive shall be modified to include a factory or SI wired output line reactor.
- B. Information included elsewhere:
  - 1. Drive feed location – See Drawings.
  - 2. Drive overall dimensions allowed – See Drawings.
  - 3. Additional control information – See Drawings.

## PART 3 - EXECUTION

### 3.1 FACTORY TESTING

- A. The drives will be completely assembled, wired, and tested in the United States of America. The following tests will be performed:
  - 1. The manufacturer shall use the ISO-9001 standards in the purchase, engineering, manufacturing and testing of the VFD system.
  - 2. Upon completion of manufacture and assembly, the drives shall be subjected to a complete factory test to demonstrate compliance with specified features and characteristics of the specification. The purchaser at his option shall be able to witness factory testing of his unit, with factory coordination.
  - 3. The testing procedure shall be the manufacturer's standard procedure (except for loss of phase) to assure maintenance free service. The buyer shall be given a 5 day notice prior to the start of factory testing for the buyer's representative to witness the testing.
  - 4. All equipment, devices, instrumentation, and personnel required to perform the factory tests shall be supplied by the manufacturer. Upon satisfactory completion of the test, the seller shall upon request submit two (2) certified copies of the test report to the buyer. Component failure during testing will require repeating any test associated with the failure or modified components to demonstrate proper operation.
  - 5. A loss of each phase testing shall be conducted at the factory to guaranty the safe and orderly shutdown of the drive under load. These tests shall conclude that the drive will not fail its electronic circuits or causes sever over heating of the bridges. These tests shall not limit the life of the drive system. There are no exceptions to this test. This test shall be performed and test reports provided to the ENGINEER prior to installation of the drive system package.

### 3.2 STARTUP AND FIELD TESTING

- A. The VFD manufacturer shall provide the services of a factory trained technician for startup assistance, programming and testing. Verification of the VFD input harmonics voltage and current distortion limits specified must be verified as part of the start-up and acceptance. If harmonics distortion requirements are not met, it is the responsibility of the VFD supplier to meet these specifications at the manufacturer's expense. Meg-ohm testing will be done to the load conductors and motor to verify condition of the equipment prior to startup. The VFD manufacturer shall certify the VFD and motor system as compatible. UL508 technicians shall not be allowed to perform startup procedures.
- B. A 10% payment retention will be released upon factory field test verification of harmonic specifications requirements and final test report and acceptance.
- C. Spare Parts
  - 1. The following spare parts shall be furnished. The net price per item shall be provided with the request for proposal. Each spare part shall be packaged and identified by part number and type for long term customer storage.
    - a. Three of each type of fuse rated 480 Volts or less.
    - b. Two of each type of converter power semi-conductor.
    - c. Two of each type of inverter power semi-conductor.
    - d. One of each type of control board, gate firing board and communication board.
    - e. One key pad assembly.
    - f. Five of each type of panel lamp.
    - g. Three of each size MOV's.

**END OF SECTION**



**SECTION 26 32 00**  
**STANDBY ENGINE GENERATOR**

**PART 1 - GENERAL**

**1.1 DESCRIPTION OF SYSTEM**

- A. Provide a standby power system to supply electrical power in event of failure of normal supply, consisting of a liquid cooled engine, an AC alternator, system controls, and sound attenuated enclosure with all necessary accessories for a complete operating system, including but not limited to the items as specified hereinafter.
- B. Provide an automatic transfer switch, specified elsewhere, as part of a packaged system such that the system comes on-line fully automatically, and on restoration of utility power automatically retransfers load to normal power, shuts down the generator and returns to readiness for another operating cycle.

**1.2 REQUIREMENTS OF REGULATORY AGENCIES**

- A. Conform to N.E.C. and applicable inspection authorities.
- B. Transfer switch(s) to be labeled under UL 1008 and shall be programmed by a factory trained and authorized representative.

**1.3 MANUFACTURER QUALIFICATIONS**

- A. These systems shall be supplied by a manufacturer who has been regularly engaged in the production of engine-alternator sets, automatic transfer switches, and associated controls for a minimum of fifteen years, thereby identifying one source of supply and responsibility.
- B. To be classified as a manufacturer, the builder of the generator set must manufacture at minimum engines or alternators.
- C. The manufacturer shall have printed literature and brochures describing the standard series specified, not a one of a kind fabrication.
- D. Manufacturers:
  - 1. Caterpillar
  - 2. Cummins
  - 3. Kohler
  - 4. Generac
- E. Substitutes: Proposed substitutions shall include complete submittal data, as specified herein and required elsewhere, clearly denoting and all deviations and/or exceptions to the equipment specified. The complete proposed substitution must be submitted in accordance with the Standard General Conditions and Supplementary Conditions.

## 1.4 WARRANTY

- A. The standby electric generating system components, complete engine-generator and instrumentation panel shall be warranted by the manufacturer against defective materials and factory workmanship for a period of 36 months or 3,000 hours, whichever is greater. This warrantee shall include freight, shipping, labor, parts, etc. for the entire generation system. Such defective parts shall be repaired or replaced at the manufacturer's option, free of charge for travel and labor. An additional 4 years of the manufacturer's standard warranty coverage shall be provided. The warranty period shall commence when the standby power system is first placed into service. Multiple warranties for individual components (engine, alternator, controls, etc.) will not be acceptable. Satisfactory warranty documents must be provided. Also, in the judgment of the specifying authority, the manufacturer supplying the warranty for the complete system must have the necessary financial strength and technical expertise with all components supplied to provide adequate warranty support.

## 1.5 SUBMITTALS

- A. Provide complete sets of Engineering Submittal for approval, prior to production release, showing all components, in addition to the engine and generator. Submittals shall show compliance with these specifications.
- B. Provide sizing calculations showing the submitted units ratings at altitude and ambient temperature.
- C. Refer to Sections 01 30 00 and 26 05 00 for additional submittal requirements.

## PART 2 - PRODUCTS

### 2.1 ENGINE

- A. The prime mover shall be a liquid cooled, Natural Gas engine of 4-cycle design. The unit requires a minimum rated output as specified in these documents.
- B. The engine is to be cooled with a unit mounted radiator, fan, water pump, and closed coolant recovery system providing visual diagnostic means to determine if the system is operating with a normal engine coolant level. The radiator shall be designed for operation in the ambient temperature conditions listed in this document. Fan and radiator shall be sized for the critical grade sound attenuated enclosure of the generator.
- C. The intake air filter with replaceable element must be mounted on the unit. Full pressure lubrication shall be supplied by a positive displacement lube oil pump. The engine shall have a replaceable oil filter with internal bypass and replaceable elements. Engine coolant and oil drain extension must be provided to outside of the mounting base for cleaner and more convenient engine servicing. A fan guard must be installed for personnel safety.

- D. The engine shall have a battery charging DC alternator with a transistorized voltage regulator. Remote 2-wire starting shall be by a solenoid shift, electric starter.
- E. Engine speed shall be governed by electronic governor to maintain alternator frequency within .5% from no load to full load alternator output. Steady state regulation is to be 0.25%.
- F. The engine fuel system shall be designed for operation with Natural Gas fuel. A fuel shutoff solenoid and all fuel lines must be installed at the point of manufacture.
- G. Sensing elements to be located on the engine for low oil pressure shutdown, high coolant temperature shutdown, low coolant level shutdown, overspeed shutdown and overcrank protection. These sensors are to be connected to the control panel using a wiring harness with the following features: wire number labeling on each end of the wire run for easy identification, a molded rubber boot to cover the electrical connection on each sensor to prevent corrosion and all wiring to be run in flexible conduit for protection from the environment and any moving objects.
- H. Engine Manufacturers:
  - 1. Caterpillar
  - 2. Cummins
  - 3. John Deere
  - 4. GM
  - 5. Perkins
  - 6. Volvo
  - 7. Generac
  - 8. Detroit Diesel

## 2.2 CAPABILITY REQUIREMENTS

- A. Generators shall have the following operation capabilities:

### Generator No. 1

Site Rated kW rating	350 kW @ 0.8 Power Factor . Confirm with drawings.
Fuel -	Natural Gas
Voltage-	480/277, Parallel Wye
Phase -	Three (3)
Frequency (Hz)	60
Altitude -	5200 feet
Ambient Temperature	-30 degrees F to 110 degrees F.
Main Breaker, Solid State with GFP, 100% Rated – Sizes as indicated on the drawings.	

## 2.3 FACTORY INSTALLED EQUIPMENT

- A. Generator Set(s) shall have solid state controller(s) as standard. Controls shall be factory installed and tested. Controllers shall be reliable, durable and accurate, have easy to read meters. Three spare inputs and one spare output shall be provided for customer programmed set points. Controller shall use an SAE format, the panel shall zero in on the affected system and identify the component responsible for the failure. Key-pad programmable set points, following items shall be standard features of controller:

1. Digital (LCD) Indication
  - a. AC Voltage (L-L)
  - b. AC amps
  - c. System Diagnostics
  - d. Frequency
  - e. DC Voltage
  - f. Coolant Temperature
  - g. Oil Pressure
  - h. RPM
  - i. Hours Run
2. Controls
  - a. Auto Start/Stop
  - b. Emergency Stop
  - c. Lamp Test
  - d. Cycle Crank
  - e. Voltage Control
  - f. Cooldown Timer
  - g. Phase Selector Switch
3. Indicating Lights
  - a. Low Oil Pressure
  - b. High Coolant Temperature
  - c. Overspeed
  - d. Overcrank
  - e. Emergency Stop
  - f. Fault Shutdown \*
  - g. Fault Alarm \*
  - h. Not in auto
  - i. Pre-Alarm

1) 1 Spare Inputs – Customer Programmable

- B. A heavy duty, lead acid battery set shall be provided by the generator set manufacturer of adequate voltage and amperage capacity to start and operate the engine. Provide all intercell and connecting battery cables as required.
- C. The manufacturer shall supply and install its recommended stainless steel, flexible connector to couple the engine exhaust manifold to the exhaust system.
- D. The engine shall have a unit mounted, thermostatically controlled water jacket heater to aid in quick starting. It will be of adequate wattage as recommended by the engine manufacturer. The contractor shall provide proper branch circuit from normal utility power source.
- E. An oil heater and thermostat shall be installed in the engine oil pan at the factory as recommended by manufacturer.
- F. A block heater and thermostat shall be installed in the engine block at the factory as recommended by manufacturer.
- G. Provide a thermostatically controlled blanket type battery heater to increase engine battery capacity for cold weather starting.
- H. Provide an automatic dual rate battery charger manufactured by the engine-generator set supplier. The automatic equalizer system shall monitor and limit the charge current to 10 amps. The output voltage is to be determined by the charge current rate. The charger must have a maximum open circuit voltage of 35 volts and be protected against a reverse polarity connection. The battery charger is to be factory installed on the generator set. Due to line voltage drop concerns, a battery charger mounted in the transfer switch will be unacceptable.

2.4 THE FOLLOWING EQUIPMENT IS TO BE PROVIDED BY THE ENGINE-GENERATOR SET MANUFACTURER AND SHIPPED LOOSE WITH THE UNIT:

- A. The manufacturer will supply its recommended flexible fuel line to connect the engine to the external fuel source. On stationary applications the fuel line shall match the fuel fitting on the unit base rail and have braided stainless steel covering with brass fittings.
- B. Installation acceptance test to be conducted on-site shall include a “cold start” test, a six-hour full load test, and a on-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank for 100% rated load and make temporary connections for full load test.

2.5 ALTERNATOR

- A. The alternator shall be a 4-pole revolving field type, 12 lead, wired for or 277/480 VAC, three phase, 60 Hz with a brushless, PMG exciter. Photosensitive components will not be permitted in the rotating exciter. The stator shall be direct connected to the engine to insure permanent alignment. The generator shall meet temperature rise standards for Class "H" insulation; operate within Class "F" standards for extended life. All leads must be extended into an AC connection panel. The alternator shall be protected by internal thermal overload protection and an automatic reset field circuit breaker.
- B. One step load acceptance shall be 100% of nameplate rating and meet the requirements of NFPA 110 paragraph 5-13.2.6. The generator set and regulator must sustain at least 90% of rated voltage for 10 seconds with 250% of rated load at near zero power factor connected to its terminals when equipped with direct or brushless excitation. 300% short circuit current must be selectable on units equipped with permanent magnet exciters. Generators equipped with permanent magnet exciters not allowing the selection of the short circuit current ratings are not allowed.
- C. A solid state voltage regulator designed and built by the engine-generator set manufacturer must be used to control output voltage by varying the exciter magnetic field to provide + or - 1% regulation during stable load conditions. Should an extremely heavy load drop the output frequency, the regulator shall have a voltage droop of 4 Volts/Hertz to maximize motor starting capability. The frequency at which this droop operation begins must be adjustable, allowing the generator set to be properly matched to the load characteristics insuring optimum system performance. Additional rheostats for matching generator voltage, droop, and stability characteristics to the specific load conditions must be available.
- D. The voltage regulator must contain a limiting circuit to prevent output voltage surges in excess of 125% of rated voltage during generator set operation. On loss or near loss of the voltage sensing signal, the voltage regulator must be capable of shutting down to prevent an overvoltage condition from occurring. It must have a second mode of operation allowing 300% of rated current to flow through the electrical distribution circuit(s) for ten (10) seconds under the same conditions. Voltage regulators not capable of selecting either mode of operation are not acceptable. LED indication will be provided on the regulator to monitor the sensing (yellow), excitation (green), and output circuit (red).
- E. A NEMA 1 panel that is an integral part of the generator set must be provided to allow the installer a convenient location in which to make electrical output connections. An isolated neutral lug must be included by the generator set manufacturer to insure proper sizing.

## 2.6 MOUNTING

- A. The electric plant shall be mounted with vibration isolators on a welded steel base that shall permit suitable mounting to any level surface.

## 2.7 PROVIDE FOLLOWING ITEMS INSTALLED AT FACTORY

- A. The unit mounted main line circuit breaker shall have an internal set of form "C" contacts that change state whenever the breaker is opened or closed. Lamps on the generator control panel shall indicate breaker position and screw terminals in the control panel shall provide appropriate system DC voltage for remote annunciation.
- B. A solid state, thermal magnetic UL listed main line circuit breaker shall be mounted in the AC connection panel. The line side connections are to be made at the factory. A system utilizing a manual reset field circuit breaker and current transformers is unacceptable.

## 2.8 CONTROLS

- A. All engine alternator controls and instrumentation shall be designed, built, wired, tested and shock mounted in a NEMA 12 enclosure to the engine-generator set by the manufacturer. It shall contain panel lighting, a fused DC circuit to protect the controls and a +/-5% voltage adjusting control. This panel must be able to be rotated 90 degrees in either direction for correct installation.
- B. The engine-generator set shall contain a complete 2 wire automatic engine start-stop control which starts the engine on closing contacts and stop the engine on opening contacts. A cyclic cranking limiter shall be provided to open the starting circuit after eight attempts if the engine has not started within that time. Engine control modules must be solid state plug-in type for high reliability and easy service. The engine controls shall also include a 3-position selector switch with the following positions: AUTO/OFF/RUN. Auto will allow full automatic operation, off disables any engine start, run starts the engine. An emergency stop switch, panel fuse, 5% voltage adjust rheostat and RS485/Ethernet communications port shall be panel mounted.
- C. A micro-processor based digital control panel will be supplied. It shall simultaneously display all operating conditions including:
  - 1. AC Volts
  - 2. AC Amperes
  - 3. Frequency
  - 4. Power Factor
  - 5. KW Output
  - 6. Oil Pressure
  - 7. Water Temperature
  - 8. Fuel level (where applicable)
  - 9. Battery Voltage
  - 10. Run Time Hours. It shall have individual LED's to indicate:
    - a. Selected Phase
    - b. High or Low AC Voltage
    - c. High or Low Battery Voltage
    - d. High or Low Frequency

- e. Low and Pre-Low Oil Pressure
  - f. Low Water level
  - g. Low Water Temperature
  - h. High and Pre-High Engine Temperature
  - i. High, Low and Critically Low Fuel Levels and Fuel in Rupture Basin (where applicable)
  - j. Emergency Stop
  - k. Overcrank
  - l. Overspeed
  - m. Unit not in Automatic Mode
  - n. Status of Main Line Circuit Breaker(where applicable)
  - o. Program Mode
11. Two additional LED's for future programming. A keypad shall allow local programming of the units operating parameters as well as testing and resetting of the alarm LED's. The keypad shall include the phase selector function.
- D. The following equipment is to be installed at the engine-generator set manufacturer's facility:
- 1. A red mushroom type emergency stop switch shall be mounted on the generator control panel and when pressed shall shutdown the engine/generator requiring a manual reset before operation can resume.
  - 2. A sensor shall be installed in the sub-base fuel tank indicating 50% of fuel remaining (where applicable). A "Low Fuel" lamp on the control panel and on the remote annunciator will illuminate when this level is reached. The alarm shall be available to the Alarm System.

## 2.9 UNIT ACCESSORIES

- A. Generator set housing shall be provided factory-assembled to generator set base and radiator cowling. Housing shall provide ample airflow for generator set operation at rated load in the ambient conditions previously specified. The housing shall have hinged side-access doors an rear control door. All doors shall be lockable. All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color using a two step electrocoating paint process, or equal meeting the performance requirements specified below. All surfaces of all metal parts shall be primed and painted. The painting process shall result in a coating which meets the following requirements:
- 1. Primer Thickness, 0.5-2.0 mils
  - 2. Top Coat Thickness, .08-1.2 mils
  - 3. Gloss, per ASTM D523-89, 80% plus or minus 5%. Gloss retention after one year shall not exceed 50%
  - 4. Crosshatch Adhesion, per ASTM D3359-93, 4B-5B



5. Impact Resistance, per ASTM D2794-93, 120-160 inch pounds
  6. Salt Spray, per ASTM B117-90, 1000+ hours
  7. Humidity, per ASTM D2247-92, 1000+ hours
  8. Water Soak, per ASTM D2247-92, 1000+ hours
- B. Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant and designed to minimize marring of the painted surface when removed for normal installation or service work.
- C. The generator set shall be provided with sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 72 dB(A) 7 meters from the nearest point of the proposed generator installation location and 60dB minimum at the edge of the nearest residential lot. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant. No foam materials shall be used unless they can be demonstrated to have the same durability and life as fiberglass. The engine-generator set shall be factory enclosed in a 12 gauge steel enclosure constructed with corner posts, uprights and headers. The roof shall aid in the runoff of water and include a drip edge. The enclosure shall be coated with electrostatically applied powder paint, baked and finished to manufacturer's specifications. The enclosure shall be completely lined with 1" thick minimum, UL 94 HF-1 listed, sound deadening material. This material must be of a self extinguishing design. The enclosure is to have large, hinged, removable doors to allow access to the engine, alternator and control panel. Hinges and all exposed fasteners will be stainless steel. Each door will have lockable hardware with identical keys. Padlocks do not meet this specification. The critical silencer shall be mounted within the enclosure to further reduce the unit sound level and provide a clean, smooth exterior design. The enclosure shall include sound insulated, baffled air intake hoods and air exhaust hoods. The generator set shall be sized to account for losses in sound baffles and critical grade appurtenances.
- D. The following equipment is to be provided by the engine-generator set manufacturer:
1. Spring type vibration isolators to mount under the engine mounting base to eliminate noise, reduce transmitted vibration and provide earthquake protection.

## **PART 3 - EXECUTION**

### **3.1 FACTORY TESTING**

- A. Before shipment of the equipment, the engine-generator set shall be tested under rated load for performance and proper functioning of control and interfacing circuits. Tests shall include:
1. Verifying all safety shutdowns are functioning properly.
  2. Single step load pick-up per NFPA 110, Paragraph 5-13.2.6.

3. Transient and voltage dip responses and steady state voltage and speed (frequency) checks.

### 3.2 OWNER'S MANUALS

- A. Three (3) sets of OWNER's manuals specific to the product supplied must accompany delivery of the equipment. General operating instruction, preventive maintenance, wiring diagrams, schematics and parts exploded views specific to this model must be included.

### 3.3 INSTALLATION

- A. CONTRACTOR shall install the complete electrical generating system including all fuel connections in accordance with the manufacturer's recommendations as reviewed by the ENGINEER.
- B. CONTRACTOR to supply all lugs required for external load connections.

### 3.4 SERVICE

- A. Supplier of the electric plant and associated items shall have permanent service facilities in this trade area. These facilities shall comprise a permanent force of factory trained service personnel on 24 hour call, experienced in servicing this type of equipment, providing warranty and routine maintenance service to afford the OWNER maximum protection. Delegation of this service responsibility for any of the equipment listed herein will not be considered fulfillment of these specifications. Service contracts shall also be available.

### 3.5 STARTUP AND CHECKOUT

- A. The supplier of the electric generating plant and associated items covered herein shall provide factory trained technicians to checkout the completed installation and to perform an initial startup inspection to include:
  1. Engine Generator/ATS Testing: See Section 17100 for requirements
    - a) Low-voltage cable insulation integrity tests shall be performed for cables connecting the generator breaker to the panelboard. Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment. The test voltage shall be 100 volts dc, applied for 30 seconds between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:
    - b)  $R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 304,800 / (\text{length of cable in meters})$
    - c)  $R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 1000 / (\text{length of cable in feet})$
    - d) Each cable failing this test shall be repaired or replaced. The repair cable shall be retested until failures have been eliminated.

2. Circuit breakers and switchgear shall be examined and tested in accordance with the manufacturer's published instructions for functional testing.

B. Inspections

The following inspections shall be performed jointly by the Contractor, after complete installation of each engine-generator set and its associated equipment, and prior to startup of the engine-generator set. Checks applicable to the installation shall be performed. The results of those which are physical inspections (I) shall be documented by the Contractor and submitted in accordance with paragraph SUBMITTALS. The Contractor shall present manufacturer's data for the inspections designated (D) at the time of inspection. Inspections shall verify that equipment type, features, accessibility, installation and condition are in accordance with the contract specification. Manufacturer's statements shall certify provision of features which cannot be verified visually.

1. Drive belts.
2. Governor type and features.
3. Engine timing mark.
4. Starting motor.
5. Starting aids.
6. Coolant type and concentration.
7. Radiator drains.
8. Block coolant drains.
9. Coolant fill level.
10. Coolant line connections.
11. Coolant hoses.
12. Combustion air filter.
13. Intake air silencer.
14. Lube oil type.
15. Lube oil sump drain.
16. Lube-oil filter.
17. Lube-oil level indicator.
18. Lube-oil fill level.
19. Lube-oil line connections.
20. Lube-oil lines.
21. Fuel type.
22. Fuel-level. (where applicable)
23. Fuel-line connections.
24. Fuel lines.
25. Fuel filter. (where applicable)
26. Access for maintenance.
27. Voltage regulator.
28. Battery-charger connections.
29. Wiring & terminations.
30. Instrumentation.
31. Hazards to personnel.
32. Base.
33. Nameplates.
34. Paint.
35. Exhaust-heat system.
36. Exhaust muffler.

37. Switchboard.
38. Switchgear.
39. Access provided to controls.
40. Enclosure is weather resistant.
41. Engine & generator mounting bolts (application).

C. Performance Tests

1. In the following tests, where measurements are to be recorded after stabilization of an engine-generator set parameter (voltage, frequency, current, temperature, etc.), stabilization is considered to have occurred when measurements are maintained within the specified bandwidths or tolerances, for a minimum of four consecutive readings. For the following tests, if any parts are changed, or adjustments made to the generator set, its controls, or auxiliaries, the associated tests shall be repeated.
  1. Continuous Engine Load Run Test:
 

Test the engine-generator set and ancillary systems at service load to demonstrate durability; verify that heat of extended operation does not adversely affect or cause failure in any part of the system; and check all parts of the system. If the engine load run test is interrupted for any reason, the entire test shall be repeated. After each change in load in the following test, measure the vibration at the end bearings (front and back of engine, outboard end of generator) in the horizontal, vertical, and axial directions. Verify that the vibration is within the allowable range. Data taken at 15 minute intervals shall include the following:  
 Electrical: Output amperes, voltage, real and reactive power, power factor, frequency.  
 Pressure: Lube-oil.  
 Temperature: Coolant, Lube-oil, Exhaust, Ambient.

    - a. Perform and record engine manufacturer's recommended prestarting checks and inspections. Include as a minimum checking of coolant fluid, fuel, and lube-oil levels.
    - b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warmup period.
    - c. Operate the engine generator-set for 2 hours at 75% of Service Load.
    - d. Increase load to 100% of Service Load and operate the engine generator-set for 4 hours.
  2. Verify that the engine-generator set responds to addition and dropping of blocks of load in accordance with the transient response requirements. Document maximum voltage and frequency variation from bandwidth and verify that voltage and frequency return to and stabilize within the specified bandwidth, within the specified response time period. Document results in tabular form and with high resolution, high speed strip chart recorders or comparable digital recorders, as approved by the Contracting Officer.

Tabular data shall include the following:

- 1) Ambient temperature (at 15 minute intervals).
- 2) Generator output current (before and after load changes).

- 3) Generator output voltage (before and after load changes).
  - 4) Frequency (before and after load changes).
  - 5) Generator output power (before and after load changes).
  - 6) Graphic representations shall include the actual instrument trace of voltage and frequency showing:
- b) Charts marked at start of test; observed steady-state band; mean of observed band; momentary overshoot and undershoot (generator terminal voltage and frequency) and recovery time for each load change together with the voltage and frequency maximum and minimum trace excursions for each steady state load condition prior to and immediately following each load change. Generator terminal voltage and frequency transient recovery time for each step load increase and decrease.
    - a. Perform and record engine manufacturer's recommended prestarting checks and inspections.
    - b. Start the engine, make and record engine manufacturer's after-starting checks and inspections during a reasonable warm-up period and no load. Verify stabilization of voltage and frequency within specified bandwidths.
    - c. With the unit at no load, apply the Maximum Step Load Increase.
    - d. Apply load in steps equal to the Maximum Step Load Increase until the addition of one more step increase will exceed the Service Load.
    - e. Decrease load to the unit such that addition of the Maximum Step Load Increase will load the unit to 100% of Service Load.
    - f. Apply the Maximum Step Load Increase.
    - g. Decrease load to zero percent in steps equal to the Maximum Step Load Decrease.
    - h. Repeat steps c. through g.
- D. Generator Fail Test:
1. Test the capability of each engine-generator set to pick up the entire load if the alternate generator fails. During operations record load-sharing characteristics of each set in parallel operation. Data taken shall include the following:
    - a) Ambient temperature (at 15 minute intervals).
    - b) Generator output current (before and after load changes).
    - c) Generator output voltage (before and after load changes).
    - d) Power division and exchange between generator sets.
    - e) Real power (watts) and reactive power (vars) on each set.
  2. Combinations
    - a) Connect each set, to the load of the system, operating at service load, until all possible two-unit-in-parallel combinations have been achieved. Verify stabilization of voltage and frequency within specified bandwidths and proportional sharing of real and reactive loads. Document stabilization of voltage and frequency within specified bandwidth, and voltage and frequency stability and transient response in the following steps for each combination.
- E. Automatic Operation Tests for Engine Generator Set:
1. The automatic operating system shall be tested to demonstrate automatic starting, the response to loss of operating engine-generator sets, and

paralleling of each engine-generator set. The loads for this test shall utilize actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

- a) Ambient temperature (at 15 minute intervals).
- b) Generator output current (before and after load changes).
- c) Generator output voltage (before and after load changes).
- d) Generator output frequency (before and after load changes).
- e) Power of each generator set.
- f) Real and reactive power on each set.

2. Initiate loss of the preferred power source and verify the specified sequence of operation.

3. Verify resetting of automatic starting and transfer logic.

F. Automatic Operation Tests for Stand-Alone Operation

1. The automatic loading system shall be tested to demonstrate automatic starting, of each engine-generator set. The loads for this test shall utilize the actual loads to be served, and the loading sequence shall be the indicated sequence. Perform this test for a minimum of two successive, successful tests. Data taken shall include the following:

- a) Ambient temperature (at 15 minute intervals).
- b) Generator output current (before and after load changes).
- c) Generator output voltage (before and after load changes).
- d) Generator output frequency (before and after load changes).
  - 1) Initiate loss of the primary power source and verify automatic sequence of operation.
  - 2) Restore the primary power source and verify sequence of operation.
  - 3) Verify resetting of controls to normal.

G. Pull the Plug System Test:

1. The contractor shall record all voltages and frequencies prior to and after each sequence of the test.
2. Contractor shall simulate a power outage by opening all circuit breakers which feed automatic transfer switches. The contractor shall then observe that the engines generators start up and run and that the transfer switches take the load. Time delays for start up and transfers of each transfer switch shall be recorded. The contractor shall verify proper operation of each automatic transfer switch.
3. Contractor shall verify proper startup and operation of all equipment including fans, pumps, chillers, alarm and monitoring systems and lighting systems.
4. Contractor shall verify proper operation of lighting systems to ensure that emergency lighting has returned. Contractor shall verify the proper operation of each fan coil unit.
5. The contractor shall verify proper operation of each UPS to ensure that power to critical loads was not interrupted.
6. The contractor shall then restore power to transfer switches by closing each of these breakers and verifying that all systems time out and retransfer, that generators cool down and subsequently shut off. All time delays shall be recorded.
7. Contractor shall then verify proper restart of all equipment as noted

- above.
8. Contractor shall then verify that each UPS maintained power to the critical load during the retransfer.
  9. Contractor shall then verify that all lighting and non-UPS systems return to normal operation.

**END OF SECTION**

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**SECTION 26 35 53**  
**SURGE PROTECTION DEVICES**

**PART 1 - GENERAL**

**1.01 SCOPE**

The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchgear, switchboards, panelboards, busway (integrated within bus plug), or motor control centers. Refer to related sections for surge requirements in:

**1.02 RELATED SECTIONS**

1. Section 262418 – Switchboards – Low Voltage
2. Section 262417 – Distribution Panelboards – Low Voltage
3. Section 262416 – Branch Circuit Panelboards - Low Voltage (Commercial Metering)

**1.03 REFERENCES**

1. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable standards
  - A. ANSI/UL 1449 4<sup>th</sup> Edition or later
  - B. ANSI/UL 1283 5<sup>th</sup> Edition or later (type 2 applications)
  - C. IEEE C62.41.1
  - D. IEEE C62.41.2
  - E. IEEE C62.43-2005
  - F. IEEE C62.45-2002
  - G. IEEE C62.48-2005
  - H. IEEE C62.62-2010
  - I. UL 96A
  - J. NFPA 780

**1.04 SUBMITTALS – FOR REVIEW/APPROVAL**

1. The following information shall be submitted to the Engineer:
  - A. Provide verification that the SPD complies with the required ANSI/UL 1449 4<sup>th</sup> Edition or later listing by Underwriters Laboratories (UL). Compliance may be in the form of a file number that can be verified on UL's website [www.ul.org](http://www.ul.org), the website should contain the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (In).

2. Where applicable the following additional information shall be submitted to the engineer:
  - A. Descriptive bulletins
  - B. Product sheets

#### 1.05 SUBMITTALS – FOR CONSTRUCTION

1. The following information shall be submitted for record purposes:
  - A. Final as-built drawings and information for items listed in Section 1.04 and shall incorporate all changes made during the manufacturing process

#### 1.06 QUALIFICATIONS

1. The manufacturer of the electrical distribution equipment shall be the manufacturer of the SPD within the electrical distribution equipment.
2. For the equipment specified herein, the manufacturer shall be ISO 14001 and ISO 9001 or 9002 certified.
3. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of twenty-five (25) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
4. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2011/65/EU and have a visible label showing compliance.
5. The SPD shall be UL 1449 current edition listed, 20 kA nominal discharge current, Type 1 or Type 2 for use in UL 96A systems.

#### 1.07 DELIVERY, STORAGE AND HANDLING

Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

#### 1.08 OPERATION AND MAINTENANCE MANUALS

Operation and maintenance manuals shall be provided with each SPD shipped.

### **PART 2 - GENERAL**

#### 2.01 MANUFACTURERS

1. Eaton

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

#### 2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

## 1. Electrical Requirements

- A. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
- B. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
- C. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
- D. Unit shall operate without the need for an external overcurrent protection device, and be listed by UL as such. Unit must not require external overcurrent protective device or replaceable internal overcurrent protective devices for the UL Listing.
- E. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

Configuration	Protection Modes			
	L-N	L-G	L-L	N-G
Wye	•	•	•	•
Delta	N/A	•	•	N/A
Single Split Phase	•	•	•	•
High Leg Delta	•	•	•	•

- F. Nominal Discharge Current ( $I_n$ ) – All SPDs applied to the distribution system shall have a 20kA  $I_n$  rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an  $I_n$  less than 20kA shall be rejected.
- G. ANSI/UL 1449 4<sup>th</sup> Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4<sup>th</sup> Edition VPR for the device shall not exceed the following:

Modes	208Y/120	480Y/277	600Y/347
L-N; L-G; N-G	700	1200	1500
L-L	1200	2000	3000

## 2. SPD Design

- A. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort

such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

- B. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
- C. Electrical Noise Filter – Each Type 2 unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
  - a. Type 2 units with filtering shall conform to UL 1283 5<sup>th</sup> Edition
  - b. Type 1 units shall not contain filtering or have a UL 1283 5<sup>th</sup> Edition Listing.
- D. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
- E. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
  - a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
    - i. For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
    - ii. For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes
    - iii. The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
  - b. Remote Status Monitor (optional) – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.

- c. Audible Alarm and Silence Button (optional) – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
- d. Surge Counter (optional) – The SPD shall be equipped with an LCD display that indicates to the user how many surges have occurred at the location. The surge counter shall trigger each time a surge event with a peak current magnitude of a minimum of  $50 \pm 20A$  occurs. A reset pushbutton shall also be standard, allowing the surge counter to be zeroed. The reset button shall contain a mechanism to prevent accidental resetting of the counter via a single, short-duration button press. In order to prevent accidental resetting, the surge counter reset button shall be depressed for a minimum of 2 seconds in order to clear the surge count total.
  - i. The ongoing surge count shall be stored in non-volatile memory. If power to the SPD is completely interrupted, the ongoing count indicated on the surge counter's display prior to the interruption shall be stored in non-volatile memory and displayed after power is restored. The surge counter's memory shall not require a backup battery in order to achieve this functionality.
- F. Thermal MOV Protection - The unit shall contain thermally protected MOVs. These self-protected MOVs shall have a thermal protection element integrated with the MOV and a mechanical disconnect with arc quenching capabilities in order to achieve overcurrent protection of the MOV. The thermal protection assembly shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.
- G. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. The use of plug in single-mode modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.
- H. Safety Requirements - The SPD shall minimize potential arc flash hazards by containing no single-mode plug in user serviceable / replaceable parts and shall not require periodic maintenance. SPDs containing items such as replaceable single-mode plug in modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
  - a. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.
  - b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

## 2.03 SYSTEM APPLICATION

1. The SPD applications covered under this section include distribution and branch panel locations, busway, motor control centers (MCC), switchgear, and switchboard assemblies. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.
2. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
Category	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Switchgear, MCC, Main Entrance)	250 kA	125 kA
B	High Exposure Roof Top Locations (Distribution Panelboards)	160 kA	80 kA
A	Branch Locations (Panelboards, MCCs, Busway)	120 kA	60 kA

## 2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

1. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.
  - A. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
  - B. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.
  - C. The panelboard shall be capable of re-energizing upon removal of the SPD.
  - D. The SPD shall be integral to the panelboard and connected directly to the bus. Alternately, an integral SPD can be connected to a circuit breaker for disconnecting purposes if a disconnect is required.
  - E. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
  - F. The SPD shall be of the same manufacturer as the panelboard.
  - G. The complete panelboard including the SPD shall be UL67 listed.

## 2.05 SWITCHGEAR, SWITCHBOARD, MCC AND BUSWAY REQUIREMENTS

- A. The SPD application covered under this section is for switchgear, switchboard, MCC, and busway locations. Service entrance located SPDs

shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.

- B. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, or busway
- C. The SPD shall be of the same manufacturer as the switchgear, switchboard, MCC, or busway
- D. The SPD shall be factory installed integral to the switchgear, switchboard, MCC, and/or bus plug at the assembly plant by the original equipment manufacturer
- E. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
- F. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
- G. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
- H. All monitoring and diagnostic features shall be visible from the front of the equipment.

## 2.06 SERVICE ENTRANCE REQUIREMENTS

- A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

## 2.07 EXAMINATION

## 2.08 FACTORY TESTING

- A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA, IEEE, and UL standards.

## 2.09 INSTALLATION

- A. The installation of the SPD shall be factory installed integral to the distribution equipment. The Contractor shall install all distribution equipment per the manufacturer's recommendations, applicable electrical codes and the contract drawings.

## 2.11 WARRANTY

- A. The manufacturer shall provide a ten (10) year warranty (15 year warranty with registration) that covers replacement of the complete unit from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local electrical code.

**END OF SECTION**



**SECTION 26 36 23**  
**AUTOMATIC TRANSFER SWITCHES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes transfer switches rated 600 V and less, including the following:
  - B. Automatic transfer switches
    - 1. Related Sections include the following:

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.
  - 1. Technical data on all major components of all transfer switches and other products described in this section. Data is required for the transfer switch mechanism, control system, cabinet, and protective devices specifically listed for use with each transfer switch. Include steady state and fault current ratings, weights, operating characteristics, and furnished specialties and accessories.
  - 2. Single Line Diagram: Show connections between transfer switch, power sources and load
- B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.
  - 1. Dimensioned outline drawings of assembly, including elevations, sections, and details including minimal clearances, conductor entry provisions, gutter space, installed features and devices and material lists for each switch specified.
  - 2. Internal electrical wiring and control drawings.

3. Interconnection wiring diagrams, showing recommended conduit runs and point-to-point terminal connections to generator set.
  4. Installation and mounting instructions, including information for proper installation of equipment to meet seismic requirements.
- C. Manufacturer and Supplier Qualification Data
1. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.
  2. The manufacturer of this equipment shall have produced similar equipment for a minimum period of 10 years. When requested, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
1. Features and operating sequences, both automatic and manual.
  2. List of all factory settings of relays, timers and protective devices; provide setting and calibration instructions where applicable.
- E. Warranty documents demonstrating compliance with the project's contract requirements.

#### 1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: The equipment supplier shall maintain a service center capable of providing training, parts, maintenance and emergency repairs to equipment, including transfer switch generator sets and remote monitoring equipment (if applicable) at the site within a response period of less than (eight hours or appropriate time period designated for Project) from time of notification.
1. The transfer switch shall be serviced by technicians employed by, and specially trained and certified by, the generator set supplier and the supplier shall have a service organization that is factory-certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

2. Submit names, experience level, training certifications, and locations for technicians that will be responsible for servicing equipment at this site.
  3. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.
- B. Source Limitations: All transfer switches are to be obtained through one source from a single manufacturer. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for products provided.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked as suitable for use in emergency, legally required or optional standby use as appropriate for the connected load.
- D. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
1. Transfer switches and enclosures shall be UL 1008 listed and labeled as suitable for use in emergency, legally required, and optional standby applications.
  2. CSA 282, Emergency Electrical Power Supply for Buildings, and CSA C22.2, No. 14-M91 Industrial Control Equipment
  3. NFPA 70, National Electrical Code. Equipment shall be suitable for use in systems in compliance with Articles 700, 701 and 702.
  4. Comply with NEMA ICS 10-1993 AC Automatic Transfer Switches
  5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
  6. EN55011, Class B Radiated Emissions and Class B Conducted Emissions
  7. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity
  8. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
  9. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
  10. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity

11. IEC 1000-4-6 Conducted Field Immunity
  12. IEC 1000-4-11 Voltage Dip Immunity
  13. IEEE 62.41, AC Voltage Surge Immunity
  14. IEEE 62.45, AC Voltage Surge Testing
- E. Comply with NFPA 99 – Essential Electrical Systems for Healthcare Facilities
  - F. Comply with NFPA 110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems, regardless of the actual circuit level.
  - G. The manufacturer shall warrant the material and workmanship of the transfer switch equipment for a minimum of one (1) year from registered commissioning and start-up, or eighteen (18) months from date of shipment.
  - H. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, and etc. during the minimum noted warranty period described above.

## 1.5 PROJECT CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service:
  1. Notify Owner no fewer than 2 days in advance of proposed interruption of electrical service.
  2. Do not proceed with interruption of electrical service without Owner's written permission.
  3. Do not energize any new service or distribution equipment without notification and permission of the Owner

## 1.6 COORDINATION

- A. Size and location of concrete bases and anchor bolt inserts shall be coordinated. Concrete, reinforcement and formwork must meet the requirements specified in Division 03. See section "INSTALLATION" for additional information on installation

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

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AUTOMATIC TRANSFER SWITCHES  
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- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cummins Power Generation
  - 2. Caterpillar
  - 3. ASCO 7000 Series
  - 4. Kohler
  - 5. Generac
- B. Equipment specifications for this Project are based on automatic transfer switches manufactured by Cummins Power Generation. Switches manufactured by other manufacturers that meet the requirement of this specification are acceptable, if approved not less than two weeks before scheduled bid date. Proposals must include a line-by-line compliance statement based on this specification.
- C. Transfer switches utilizing molded case circuit breakers do not meet the requirements of this specification and will not be accepted.

## 2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

- A. Provide transfer switches in the number and ratings that are shown on the drawings.
- B. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer.
- C. Fault-Current Closing and Withstand Ratings: UL 1008 WCR ratings must be specifically listed as meeting the requirements for use with protective devices at installation locations, under specified fault conditions. Withstand and closing ratings shall be based on use of the same set of contacts for the withstand test and the closing test. Fault current rating shall be fully rated with breakers protecting switch. Coordinate with panelboard vendor.
- D. Solid-State Controls: All settings should be accurate to +/- 2% or better over an operating temperature range of - 40 to + 60 degrees C (- 40 to + 140 degrees F).
- E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

- F. Electrical Operation: Accomplished by a non-fused, momentarily energized solenoid or electric motor operator mechanism, mechanically and electrically interlocked in both directions (except that mechanical interlock is not required for closed transition switches). All switches shall include a center off delay (delayed transition) function to allow for motor loads to slow.
- G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.
1. Switches using molded-case switches or circuit breakers, or insulated case circuit breaker components are not acceptable.
  2. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the Source 1 and Source 2 positions.
  3. Main switch contacts shall be high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
  4. Contacts shall be operated by a high-speed electrical mechanism that causes contacts to open or close within three electrical cycles from signal.
  5. Transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
  6. The transfer switch shall include the mechanical and control provisions necessary to allow the device to be field-configured for operating speed. Transfer switch operation with motor loads shall be as is recommended in NEMA MG1.
    - a. Phase angle monitoring/timing equipment is not an acceptable substitute for this functionality
  7. Transfer switches designated on the drawings as “4-pole” shall have a full current-rated neutral bar with lugs.
- H. Factory wiring: Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism

- I. Terminals: Terminals shall be pressure type and appropriate for all field wiring. Control wiring shall be equipped with suitable lugs, for connection to terminal strips.
- J. Enclosures: All enclosures shall be third-party certified for compliance to NEMA ICS 6 and UL 508, unless otherwise indicated:
  - 1. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70, regardless of the direction from which the conduit enters the enclosure.
  - 2. Exterior cabinet doors shall provide complete protection for the system's internal components. Doors must have permanently mounted key-type latches. Bolted covers or doors are not acceptable.
  - 3. Transfer switches shall be provided in enclosures that are third party certified for their intended environment per NEMA requirements.

## 2.3 AUTOMATIC TRANSFER SWITCHES

- A. Comply with requirements for Level 1 equipment according to NFPA 110.
- B. Indicated current ratings:
  - 1. Refer to the Project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosure type, and accessories.
  - 2. Main contacts shall be rated for 600 VAC minimum.
  - 3. Transfer switches shall be rated to carry 100% of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C (-40 to +140 degrees F), relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000 meters).
- C. Relay Signal: Control shall include provisions for addition of a pre-transfer relay signal, adjustable from 0 to 60 seconds, to be provided if necessary for elevator operation, based on equipment provided for the project.
- D. Transfer switches that are designated on the drawings as 4-pole shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.
- E. Automatic Transfer Switch Control Features
  - 1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600 VAC. Voltage sensing shall be

monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.

2. All transfer switch sensing shall be configurable from an operator panel or from a Windows XP or later PC-based service tool. Designs utilizing DIP switches or other electromechanical devices are not acceptable.
3. The transfer switch shall provide a relay contact signal prior to transfer or re-transfer. The time period before and after transfer shall be adjustable in a range of 0 to 60 seconds.
4. The control system shall be designed and prototype tested for operation in ambient temperatures from - 40 degrees C to + 60 degrees C (- 40 to +140 degrees F). It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
5. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.
6. The transfer switch network monitoring equipment, when supplied, shall be provided with a battery-based auxiliary power supply to allow monitoring of the transfer switch when both AC power sources are non-operational.
7. Transfer switch shall be equipped with load shed option to drop load if the fire pump starts. See sequence of operation.

F. Transfer Switch Control Panel: The transfer switch shall have a microprocessor-based control with a sealed membrane panel incorporating pushbuttons for operator-controlled functions, and LED lamps for system status indicators. The panel shall also include an alphanumeric display for detailed system information. Panel display and indicating lamps shall include permanent labels.

1. The indicator panel LEDs shall display:
  - a. Which source the load is connected to (Source 1 or Source 2)
  - b. Which source or sources are available
  - c. When switch is not set for automatic operation, the control is disabled
  - d. When the switch is in test/exercise mode



2. The indicator shall have pushbuttons that allow the operator to activate the following functions:
  - a. Activate pre-programmed test sequence
  - b. Override programmed delays, and immediately go to the next operation
  - c. Reset the control by clearing any faults
  - d. Test all of the LEDs by lighting them simultaneously
3. The alphanumeric digital display shall be vacuum fluorescent-type, clearly visible in both bright sunlight and no-light conditions over an angle of 120 degrees, and shall display the following:
  - a. AC voltage for all phases, normal and emergency
  - b. Source status: connected or not connected.
4. The display panel shall be password-protected, and allow the operator to view and make adjustments:
  - a. Set nominal voltage and frequency for the transfer switch
  - b. Adjust voltage and frequency sensor operation set points
  - c. Set up time clock functions
  - d. Set up load sequence functions
  - e. Enable or disable control functions including program transition
  - f. View real-time clock data, operation log (hours connected, times transferred, failures) and service history

G. Control Functions: Functions managed by the control shall include:

1. Software adjustable time delays:
  - a. Engine start (prevents nuisance genset starts in the event of momentary power fluctuation): 0 to 120 seconds (default 3 sec)
  - b. Transfer normal to emergency (allows genset to stabilize before load is transferred): 0 to 120 seconds (default 3 sec)
  - c. Re-transfer emergency to normal (allows utility to stabilize before load is transferred from genset): 0 to 30 minutes (default 3 sec)

- d. Engine cooldown: 0 to 30 minutes (default 10 min)
  - e. Programmed Delayed Transition (Center Off Delay): 0 to 60 seconds (default 3 sec)
- 2. Undervoltage sensing: three-phase normal, three-phase emergency source.
- 3. Over-voltage sensing: three-phase normal, three-phase emergency source.
- 4. Over/under frequency sensing:
  - a. Pickup: +/- 5 to +/-20% of nominal frequency (default 10%)
  - b. Dropout: +/-1% beyond pickup (default 1%)
  - c. Dropout time delay: 0.1 to 15.0 seconds (default 5 sec)
  - d. Accurate to within +/- 0.05 Hz
- 5. Voltage imbalance sensing:
  - a. Dropout: 2 to 10% (default 4%)
  - b. Pickup: 90% of dropout
  - c. Time delay: 2.0 to 20 seconds (default 5 sec)
- 6. Phase rotation sensing:
  - a. Time delay: 100 msec
- 7. Loss of single-phase detection:
  - a. Time delay: 100 msec
- H. Control features shall include:
  - 1. Programmable genset exerciser: A field-programmable control shall periodically start and run the generator with or without transferring the load for a preset time period, then re-transfer and shut down the generator after a preset cool-down period.
  - 2. In event of a loss of power to the control, all control settings, real-time clock setting and the engine start-time delay setting will be retained.
  - 3. The system continuously logs information including the number of hours each source has been connected to the load, the number of times

transferred, and the total number of times each source has failed. An event recorder stores information, including time and date-stamp, for up to 50 events.

4. Re-Transfer Inhibit Switch: Inhibits automatic re-transfer control so automatic transfer switch will remain connected to emergency power source as long as it is available regardless of condition of normal source.
5. Transfer Inhibit Switch: Inhibits automatic transfer control so automatic transfer switch will remain connected to normal power source regardless of condition of emergency source.

I. Control Interface

1. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

J. Engine Starting Contacts

1. One isolated and normally closed pair of contacts rated 10A at 32 VDC minimum.

## 2.4 REMOTE ANNUNCIATOR SYSTEM

A. Functional Description: Remote annunciator panel shall annunciate conditions for indicated transfer switches. Annunciation shall include the following:

1. Sources available, as defined by actual pickup and dropout settings of transfer-switch controls.
2. Switch position.
3. Switch in test mode.
4. Failure of communication link.

B. Annunciator Panel: LED-lamp type with audible signal and silencing switch.

C. Indicating Lights: Grouped for each transfer switch monitored.

D. Label each group, indicating transfer switch it monitors, location of switch, and identity of load it serves.

E. Switch in test mode.

F. Lamp Test: Push-to-test or lamp-test switch on front panel.

- G. Malfunction of annunciator or communication link shall not affect functions of automatic transfer switch. In the event of failure of communication link, automatic transfer switch automatically reverts to stand-alone, self-contained operation.
- H. Automatic transfer-switch sensing, controlling, or operating function shall not depend on remote panel for proper operation. The remote annunciation system shall not prevent transfer to the alternate source when the primary power source fails, nor prevent return to the primary source if the alternate source fails.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Floor-Mounting Switch: Anchor to floor by bolting.
  - 1. Floor-mounted transfer switches (except drawout switches supported by wheeled carriages, which must be rolled out at floor level) shall be mounted on concrete bases complying with the following requirements:
    - a. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 4 inches (100 mm) in all directions beyond the maximum dimensions of switch, unless otherwise indicated or unless required for seismic support. Construct concrete bases according to Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Annunciator Panel Mounting: Flush in wall, unless otherwise indicated.
- D. Identify components according to Division 26 Section "Identification for Electrical Systems."
- E. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

### **3.2 CONNECTIONS**

- A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
- B. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.

- C. Transfer switch shall be provided with AL/CU mechanical lugs sized to accept the full output rating of the switch. Lugs shall be suitable for the number and size of conductors shown on the drawings.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.3 SOURCE QUALITY CONTROL

- A. Prior to shipping, factory shall test and inspect components, assembled switches, and associated equipment to ensure proper operation.
- B. Factory shall check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements.
- C. Factory shall perform dielectric strength test complying with NEMA ICS 1.

### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: The supplier of the transfer switch(es) and associated equipment shall inspect, test, and adjust components, assemblies, and equipment installations, including connections, and report results in writing.
- B. Manufacturer's representative shall perform tests and inspections and prepare test reports.
- C. After installing equipment and after electrical circuitry has been energized, installer shall test for compliance with requirements.
  - 1. Perform recommended installation tests as recommended in manufacturer's installation and service manuals.
  - 2. After energizing circuits, demonstrate interlocking sequence and operational function for each switch.
    - a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
    - b. Verify time-delay settings.

- c. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

### 3.5 DEMONSTRATION

- A. After generator set installation, the generator and transfer switch supplier shall conduct a complete operation, basic maintenance, and emergency service seminar covering generator set and transfer switch equipment, for up to 10 people employed by the Owner.
  - 1. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, and emergency operation procedures.
  - 2. The class duration shall be at least 8 hours in length, and include practical operation with the installed equipment.

**END OF SECTION**

**SECTION 26 41 00**  
**LIGHTNING PROTECTION**

**PART 1 - GENERAL**

**1.1 SCOPE**

Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

- A. Air terminals and interconnecting conductors.
- B. Grounding and bonding for lightning protection.

**1.2 APPLICABLE SECTIONS**

The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;

- A. Section 26 05 00 - Electrical General Requirements.
- B. Section 26 05 19 - Conductors and Cables.

**1.3 REFERENCES**

- A. LPI-175 - Lightning Protection Installation Standard.
- B. LPI-176 - Lightning Protection System Material and Components Standard.
- C. LPI-177 - Inspection Guide for LPI Certified Systems.
- D. NFPA 78 - Lightning Protection Code.
- E. UL 96 - Lightning Protection Components.
- F. UL 96A - Installation Requirements for Lightning Protection Systems.

**1.4 SYSTEM DESCRIPTION**

- A. Lightning Protection System: Conductor system protecting consisting of air terminals on roofs, roof-mounted mechanical equipment, chimneys and stacks, parapets, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors.

**1.5 SUBMITTALS FOR REVIEW**

- A. Section 26 05 00 – Electrical General Requirements: Procedures for submittals.
- B. Shop Drawings: Indicate layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes, and connection and termination details.
- C. Product Data: Provide dimensions and materials of each component, and include indication of listing in accordance with UL 96.

## 1.6 PROJECT CLOSEOUT SUBMITTALS

- A. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

## 1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 70.
- B. Perform Work in accordance with UL 96A
- C. Perform Work in accordance with LPI-175

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in lightning protection equipment with minimum three years experience and member of the Lightning Protection Institute.
- B. Installer: Authorized installer of manufacturer with minimum three years experience and certified by the Lightning Protection Institute.

## 1.9 REGULATORY REQUIREMENTS

- A. Product Listing: UL 96 and LPI-176.
- B. System shall be UL listed and certified.

## 1.10 FIELD MEASUREMENTS

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

## 1.11 COORDINATION

- A. Coordinate work with roofing and exterior and interior finish installations.

# **PART 2 - PRODUCTS**

## 2.1 MANUFACTURERS AND INSTALLERS

- A. VFC Corporation. North Salt Lake, Utah.
- B. Robbins Lightning, Inc.

## 2.2 COMPONENTS

- A. Air Terminals: Copper solid with adhesive bases for single-ply roof installations.
- B. Air Terminal for Chimney: Lead-coated copper.
- C. Grounding Rods: Solid copper
- D. Ground Plate: Copper.
- E. Conductors: Copper cable
- F. Connectors and Splices: Bronze



## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install in accordance with NFPA 78, UL 96A and LPI-175.
- B. Connect conductors using exothermic welding process. Protect adjacent construction elements and finishes from damage. All welds shall be witnessed by the OWNER.
- C. Bond exterior metal bodies on building to lightning protection system and provide intermediate level interconnection loops 60 feet (18 m) on center.

### **3.2 FIELD QUALITY CONTROL**

- A. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and labeling of the lightning protection system in accordance with UL 96A.
- B. Obtain the services of the Lightning Protection Institute to provide inspection and certification of lightning protection system in accordance with LPI-177.

**END OF SECTION**

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**SECTION 26 51 13**  
**INTERIOR LUMINAIRES**

**PART 1 - GENERAL**

**1.01 SCOPE**

- A. Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:
  - 1. Interior luminaires and accessories.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Ballasts.
  - 5. Fluorescent lamp emergency power supply.
  - 6. Lamps.
  - 7. Luminaire accessories.

**1.02 APPLICABLE SECTIONS**

- A. The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;
- B. Section 260500- Electrical General Requirements.

**1.03 REFERENCES**

- A. ANSI C78.379 - Electric Lamps - Incandescent and Issued October 1993 High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.
- B. ANSI C82.1 - Ballasts for Fluorescent Lamps -Specifications.
- C. ANSI C82.4 - Ballasts for High-Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Type).
- D. NEMA WD 6 - Wiring Devices-Dimensional Requirements.
- E. NFPA 70 - National Electrical Code.
- F. NFPA 101 - Life Safety Code.

**1.04 SUBMITTALS FOR REVIEW**

- A. Section 260500 - Electrical General Requirements
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

**1.05 SUBMITTALS FOR CLOSEOUT**

- A. Section 260500 - Electrical General Requirements
  - B. Submit manufacturer's operation and maintenance instructions for each product.
- 1.06 QUALIFICATIONS
- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.
- 1.07 REGULATORY REQUIREMENTS
- A. Conform to requirements of NFPA 70.
  - B. Conform to requirements of NFPA 101.
  - C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.
- 1.08 EXTRA PRODUCTS
- A. Section 260500 - Contract Closeout.
  - B. Furnish 10% or a minimum of two of each lens type.
  - C. Furnish one case of replacement fluorescent lamps for each lamp type. Furnish two replacement lamps for each size HID lamp type and LED assembly.
  - D. Furnish 10% or a minimum of two of each ballast type or driver type.

## **PART 2 - PRODUCTS**

### **2.01 LUMINAIRES**

- A. Furnish Products as scheduled. Refer to Section 260500 for substitutions and product options.
- B. Lighting Fixtures: Shall be as shown in the Lighting Fixture Schedule on the Drawings.

### **2.04 LED LUMINAIRE WARRANTY**

- A. Provide a written 5-year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.
  - 1. Include finish warranty to include failure and substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
  - 2. Material warranty must include:
    - a. All drivers.
    - b. Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.
- B. Warranty period must begin on date of beneficial occupancy. Provide the Contracting Officer with signed warranty certificates prior to final payment.

### **2.05 PROVIDE LUMINAIRE USEFUL LIFE CERTIFICATE**

Submit certification from the manufacturer indicating the expected useful life of the

luminaires provided. The useful life must be directly correlated from the IES LM-80 test data using procedures outlined in IES TM-21. Thermal properties of the specific luminaire and local ambient operating temperature and conditions must be taken into consideration.

## 2.06 LUMINAIRES

UL 1598, NEMA C82.77, and UL 8750. Provide luminaires as indicated in luminaire schedule and NL plates or details on project plans. Provide luminaires complete with light sources of quantity, type, and wattage indicated. Provide all luminaires of the same type by the same manufacturer. Luminaires must be specifically designed for use with the driver, ballast or generator and light source provided.

## 2.07 LED LUMINAIRES

Provide luminaires complete with power supplies (drivers) and light sources. Provide design information including lumen output and design life in luminaire schedule on project plans for LED luminaires.

LED luminaires must meet the minimum requirements in the following table:

LUMINAIRE TYPE	MINIMUM LUMINAIRE EFFICACY (LE)	MINIMUM COLOR RENDERING INDEX (CRI)
LED TROFFER – 1 x 4300 x 1200 2 x 2600 x 600 2 x 4600 x 1200	90 LPW	80
LED Downlight	50 LPW	90
LED Track or Accent	40 LPW	80
LED Low Bay/High Bay	80 LPW	70
LED Linear Ambient	80 LPW	80

LED luminaires must also meet the following minimum requirements:

- A. Luminaires must have a minimum 5-year manufacturer's warranty.
- B. Luminaires must have a minimum L70 lumen maintenance value of 50,000 hours as calculated by IES TM-21, with data obtained per IES LM-80 requirements.
- C. Luminaire drive current value must be identical to that provided by test data for luminaire in question.
- D. Luminaires must be tested to IES LM-79 and IES LM-80 standards, with the results provided as required in the Submittals paragraph of this specification.

## 2.08 FLUORESCENT LUMINAIRES

Fluorescent luminaires are not acceptable.

## 2.09 HIGH INTENSITY DISCHARGE (HID) LUMINAIRES

HID Luminaires are not acceptable.

## 2.10 LUMINAIRES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide LED luminaires for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

## 2.11 LED DRIVERS

NEMA SSL 1, UL 8750. LED drivers must be electronic, UL Class 1, constant-current type and comply with the following requirements:

- A. Output power (watts) and luminous flux (lumens) as shown in luminaire schedule for each luminaire type to meet minimum luminaire efficacy (LE) value provided.
- B. Factor (PF) greater than or equal to 0.9 over the full dimming range when provided.
- C. Current draw Total Harmonic Distortion (THD) of less than 20 percent.
- D. Class A sound rating.
- E. Operable at input voltage of 120-277 volts at 60 hertz.
- F. Minimum 5-year manufacturer's warranty.
- G. RoHS compliant.
- H. Integral thermal protection that reduces or eliminates the output power if case temperature exceeds a value detrimental to the driver.
- I. UL listed for dry or damp locations typical of interior installations.
- J. Non-dimmable, or fully-dimmable to 1% using 0-10V, or 3 wire, control as indicated in luminaire schedule and on drawings.

## 2.16 LIGHT SOURCES

NEMA ANSLG C78.377, NEMA SSL 3. Provide type and wattage as indicated in luminaire schedule on project plans.

### A. LED Light Sources

1. Correlated Color Temperature (CCT) between 3000 and 5000 degrees K as indicated.
2. Minimum Color Rendering Index (CRI) R9 value of 80.
3. High power, white light output utilizing phosphor conversion (PC) process or mixed system of colored LEDs, typically red, green and blue (RGB).
4. RoHS compliant.
5. Provide light source color consistency by utilizing a binning tolerance within a 3 step McAdam ellipse.

## 2.17 CONTROLS

A. Dual Technology Wall Mounted Occupancy Sensors: Spaces indicated on drawings shall be equipped with a dual technology occupancy sensor DT-100L as manufacturer by Wattstopper or equal. The sensors shall be connected to a power supply as specified above. The sensor shall comply with the following specifications:

1. Shall utilize PIR and Ultrasonic technologies with an adjustable integrated light level sensor for 2.5 to 430 foot-candles. The output shall be a single-pole, double-throw isolated relay.
2. Shall utilize 40Khz +/- .006% ultrasonic frequency.
3. Shall provide an adjustable time delay of 15 seconds to 15 minutes and an LED indicator for both technologies.
4. Shall provide adjustable sensitivities, and shall be capable of installing two units per power pack.
5. Shall be UL listed with a 5 year warranty.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
- B. Support luminaires independent of ceiling grid, if layin type ceilings or concealed spline ceilings ore used.
- C. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

### 3.02 INSTALLATION OF LIGHTING FIXTURES

- A. Install all lighting fixtures complete and ready for service, in accordance with the Fixture Schedule on the Drawings:
- B. Wire all fixtures with fixture wiring of at least 150 degree C rating. Conductors in wiring channels of fixtures mounted in rows shall be the same size as the circuit

wiring supplying the rows.

- C. Install all fixtures straight and true with reference to adjacent walls.
  - D. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the fixture is supported either directly or indirectly by a sound and safe structural member of the building, using adequate number and type of fasteners to ensure a safe installation. Screwed fastenings and toggles through ceiling or wall material are not acceptable. Provide suitable connectors or collars to connect adjoining fixtures in continuous rows.
  - E. Do not support fixtures from roof deck. Provide unistrut channels spanning space between roof joists to support fixtures and outlets.
  - F. Fixtures mounted in lay-in grid ceilings shall have safety support wires to structural roof members as detailed for seismic restraint.
  - G. All single outlets shall be properly centered in each room. Where two or more outlets occur, they shall be spaced uniformly and in straight lines with each other.
  - H. Provide plaster frames and support channels around ceiling openings for recessed fixtures. Securely fasten to ceiling structural members.
  - I. Terminate circuits for recessed fixtures in an extension outlet box adjacent to ceiling opening and connect to fixtures with flexible steel conduit.
- 3.03 Where lighting fixtures and other electrical items are shown in conflict with locations and structural members and mechanical or other equipment, provide all required supports and wiring to clear the encroachment.
- 3.04 ADJUSTING
- A. Section 260500 Contract Closeout
- 3.05 CLEANING
- A. Section 260500 - Contract Closeout: Cleaning installed work.
  - B. Clean electrical parts to remove conductive and deleterious materials.
  - C. Remove dirt and debris from enclosures.
  - D. Clean photometric control surfaces as recommended by manufacturer.
  - E. Clean finishes and touch up damage.
- 3.06 DEMONSTRATION AND INSTRUCTIONS
- A. Section 260500 - Contract Closeout - Starting of Systems: Demonstrating installed work.
  - B. Demonstrate luminaire operation for 12 hours.
- 3.07 PROTECTION OF FINISHED WORK
- A. Re-lamp or repair/replace luminaires that have failed at substantial completion.

## **END OF SECTION**



**SECTION 26 56 00**  
**AREA LIGHTING**

**PART 1 - GENERAL**

1.01 SCOPE

- A. Furnish all labor, materials, equipment, appliances and perform all operations in connection with, and complete in strict accordance with, this section of specifications and the applicable drawings and subject to the terms and conditions of the contract for the following work:

Exterior area, façade and landscape lighting.

1.02 APPLICABLE SECTIONS

- A. The General Conditions, Supplementary General Conditions, alternates and Addenda, applicable drawings and the technical specification including but not limited to the following;
- B. Section 260500- Electrical General Requirements.

1.03 REFERENCES

(NEW)

1.04 SUBMITTALS FOR REVIEW

- A. Section 260500 - Electrical General Requirements
- B. Shop Drawings: Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.05 SUBMITTALS FOR CLOSEOUT

- A. Section 260500 - Electrical General Requirements
- B. Submit manufacturer's operation and maintenance instructions for each product.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience.

1.07 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Conform to requirements of NFPA 101.
- C. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

1.08 EXTRA PRODUCTS

- A. Section 260500 - Contract Closeout.
- B. Furnish 10% or a minimum of two of each lens type.
- C. Furnish one case of replacement fluorescent lamps for each lamp type. Furnish

replacement lamps for each size HID lamp type and LED assembly.

D. Furnish 10% or a minimum of two of each ballast type or driver type.

## 1.09 REFERENCES

The publications listed below form a part of this specification to the extent referenced.  
The publications are referred to in the text by the basic designation only.

### AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR- CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 189.1	(2014) Standard for the Design of High-Performance Green Buildings Except Low- Rise Residential Buildings
ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.1 - SI	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

### ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	(2013) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	(2016) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B108/B108M	(2015) Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B117	(2016) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM C1089	(2013) Standard Specification for Spun Cast Prestressed Concrete Poles
ASTM G154	(2016) Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

### CALIFORNIA ENERGY COMMISSION (CEC)

CEC Title 24 03/2025 083.78.100	(2008; Effective Jan 2010) California's Energy AREA LIGHTING 26 56 00- 2
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Efficiency Standards for Residential and  
Nonresidential Buildings

ILLUMINATING ENGINEERING SOCIETY (IES)

- IES HB-10 (2011; Errata 2015) IES Lighting Handbook
- IES LM-79 (2008) Electrical and Photometric  
Measurements of Solid-State Lighting Products
- IES LM-80 (2015) Measuring Lumen Maintenance of LED Light  
Sources
- IES RP-16 (2010; Addendum A 2008; Addenda B 2009;  
Addendum C 2016) Nomenclature and Definitions  
for Illuminating Engineering
- IES RP-8 (2014) Roadway Lighting
- IES TM-15 (2011) Luminaire Classification System for Outdoor  
Luminaires
- IES TM-21 (2011; Addendum B 2015) Projecting Long Term  
Lumen Maintenance of LED Light Sources

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- ANSI ANSLG C78.41 (2006) For Electric Lamps--Guidelines for Low-  
Pressure Sodium Lamps
- ANSI ANSLG C78.42 (2009; R 2016) For Electric Lamps:  
High-Pressure Sodium Lamps
- ANSI C136.13 (2004; R 2009) American National Standard for  
Roadway Lighting Equipment, Metal Brackets for  
Wood Poles
- ANSI C136.21 (2014) American National Standard for Roadway  
and Area Lighting Equipment - Vertical Tenons  
Used with Post-Top-Mounted Luminaires
- ANSI C136.3 (2014) American National Standard for  
Roadway and Area Lighting Equipment

## Luminaire Attachments

ANSI C78.1381	(1998) American National Standard for Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
ANSI C82.4	(2002) American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
ANSI/ANSLG C78.43	(2013) American National Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
ANSI/NEMA C78.LL 1256	(2003; R 2015) Procedures for Fluorescent Lamp Sample Preparation and the Toxicity Characteristic Leaching Procedure (TCLP)
NEMA 250	(2014) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ANSLG C78.377	(2015) American National Standard for Electric Lamps— Specifications for the Chromaticity of Solid State Lighting Products
NEMA ANSLG C78.380	(2007) Electric Lamps - High Intensity Discharge Lamps, Method of Designation
NEMA ANSLG C78.44	(2008) For Electric Lamps - Double-Ended Metal Halide Lamps
NEMA ANSLG C82.11	(2011) Lamp Ballasts - High-Frequency Fluorescent Lamp Ballasts
NEMA ANSLG C82.14	(2006) Lamp Ballasts Low-Frequency Square Wave Electronic Ballasts -- for Metal Halide Lamps
NEMA C136.10	(2010) American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing
NEMA C136.20	(2012) American National Standard for Roadway and Area Lighting Equipment - Fiber Reinforced Composite (FRC) Lighting Poles

NEMA C136.31	(2010) American National for Roadway and Area Lighting Equipment - Luminaire Vibration
NEMA C78.LL 3	(2003; R 2015) Electric Lamps - Procedures for High Intensity Discharge Lamp Sample Preparation and the Toxicity Characteristic Leaching Procedure
NEMA C82.77	(2002) Harmonic Emission Limits - Related Power Quality Requirements for Lighting Equipment
NEMA ICS 2	(2000; R 2005; Errata 2008) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	(1993; R 2011) Industrial Control and Enclosure Systems
NEMA IEC 60529	(2004) Degrees of Protection Provided by Enclosures (IP Code)
NEMA WD 7	(2011; R 2016) Occupancy Motion Sensors Standard

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2017) National Electrical Code
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#### UNDERWRITERS LABORATORIES (UL)

UL 1029	(1994; Reprint Dec 2013) High-Intensity-Discharge Lamp Ballasts
UL 1310	(2011; Reprint Dec 2014) UL Standard for Safety Class 2 Power Units
UL 1598	(2008; Reprint Oct 2012) Luminaires
UL 773	(1995; Reprint Jul 2015) Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	(2016) Standard for Nonindustrial Photoelectric Switches for Lighting Control
UL 8750	(2015; Reprint Nov 2016) UL Standard for Safety Light Emitting Diode (LED) Equipment for Use in Lighting Products

UL 916 (2007; Reprint Aug 2014) Standard for Energy Management Equipment

UL 935 (2001; Reprint Aug 2014) Standard for Fluorescent-Lamp Ballasts

#### 1.10 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

#### 1.11 LED LUMINAIRE WARRANTY

Provide Luminaire Useful Life Certificate.

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

- A. Provide a written five year on-site replacement warranty for material, fixture finish, and workmanship. On-site replacement includes transportation, removal, and installation of new products.
  - 1. Finish warranty shall include warranty against failure and against substantial deterioration such as blistering, cracking, peeling, chalking, or fading.
  - 2. Material warranty shall include:
    - a. All power supply units (drivers).
    - b. Replacement when more than 10 percent of LED sources in any lightbar or subassembly(s) are defective or non-starting.
- B. Warranty period must begin on date of beneficial occupancy. Contractor shall provide the Contracting Officer signed warranty certificates prior to final payment.

#### 1.13 ELECTRONIC BALLAST WARRANTY

Furnish the electronic ballasts manufacturer's warranty. The warranty period shall not be less than five (5) years from the date of manufacture. Ballast assembly in the lighting fixture, transportation, and on-site storage shall not exceed twelve (12) months, thereby permitting four (4) years of the five (5) year warranty to be in service and energized. The warranty shall state that the malfunctioning ballast shall be exchanged by the manufacturer and promptly shipped to the using Government facility.

The replacement ballast shall be identical to, or an improvement upon, the original design of the malfunctioning ballast.

## PART 2 - PRODUCTS

### 2.01 LUMINAIRES

- A. Furnish Products as scheduled. Refer to Section 260500 for substitutions and product options.
- B. Lighting Fixtures: Shall be as shown in the Lighting Fixture Schedule on the Drawings.

## 2.02 GENERAL REQUIREMENTS

- A. Housings for luminaires shall be die cast, extruded, or fabricated aluminum. Fabricated aluminum housings shall have all seams and corners internally welded to resist weathering, moisture and dust.
- B. Luminaires shall be rated for operation within an ambient temperature range of minus 22 degrees F to 104 degrees F.
- C. Luminaires shall be UL listed for wet locations per UL 1598. Optical compartment for LED luminaires shall be sealed and rated a minimum of IP65 per NEMA IEC 60529.
- D. LED luminaires shall produce a minimum efficacy as shown in the following table, tested per IES LM-79. Theoretical models of initial raw LED lumens per watt are not acceptable.

Application	Luminaire Efficacy in Lumens per Watt
Exterior Pole/Arm-Mounted Area and Roadway Luminaires	65
Exterior Pole/Arm-Mounted Decorative Luminaires	65
Exterior Wall-Mounted Area Luminaires	60
Bollards	35
Parking Garage Luminaires	70

- E. Luminaires shall have IES distribution and NEMA field angle classifications as indicated in luminaire schedule on project plans per IES HB-10.
- F. Housing finish shall be baked-on enamel, anodized, or baked-on powder coat paint. Finish shall be capable of surviving ASTM B117 salt fog environment testing for 2500 hours minimum without blistering or peeling.
- G. Luminaires shall be fully assembled and electrically tested prior to shipment from factory.
- H. The finish color shall be as indicated in the luminaire schedule or detail on the project plans.
- I. Luminaire arm bolts shall be 304 stainless steel or zinc-plated steel.
- J. Lenses shall be constructed of clear or frosted tempered glass polycarbonate vandal-resistant lenses as indicated.

- K. The wiring compartment on pole-mounted, street and area luminaires must be accessible without the use of hand tools to manipulate small screws, bolts, or hardware.
- L. Incorporate modular electrical connections, and construct luminaires to allow replacement of all or any part of the optics, heat sinks, power supply units, ballasts, surge suppressors and other electrical components using only a simple tool, such as a manual or cordless electric screwdriver.
- M. Luminaires shall have a nameplate bearing the manufacturer's name, address, model number, date of manufacture, and serial number securely affixed in a conspicuous place. The nameplate of the distributing agent will not be acceptable.

## **2.03 LUMINAIRE LIGHT SOURCES**

### **2.04 LED LIGHT SOURCES**

- A. Correlated Color Temperature (CCT) shall be in accordance with NEMA ANSLG C78.377:
  - 1. Nominal CCT: 4000 degrees K: 3985 plus or minus 275 degrees K
- B. Color Rendering Index (CRI) shall be:
  - 1. Greater than or equal to 70 for 4000 degrees K light sources.
- C. Color Consistency:
  - 1. Manufacturer shall utilize a maximum 4-step MacAdam ellipse binning tolerance for color consistency of LEDs used in luminaires.

## **2.05 LUMINAIRE DRIVERS**

- A. LED POWER SUPPLY UNITS (DRIVERS)
- B. UL 1310. LED Power Supply Units (Drivers) shall meet the following requirements:
  - 1. Minimum efficiency shall be 85 percent.
  - 2. Drive current to each individual LED shall not exceed 600 mA, plus or minus 10 percent.
  - 3. Shall be rated to operate between ambient temperatures of minus minus 22 degrees F and 104 degrees F.
  - 4. Shall be designed to operate on the voltage system to which they are connected, typically ranging from 120 V to 480 V nominal.
  - 5. Operating frequency shall be: 50 or 60 Hz.
  - 6. Power Factor (PF) shall be greater than or equal to 0.90.
  - 7. Total Harmonic Distortion (THD) current shall be less than or equal to 20 percent.
  - 8. Shall meet requirements of 47 CFR 15, Class B.
  - 9. Shall be RoHS-compliant.
  - 10. Shall be mounted integral to luminaire. Remote mounting of power supply is not allowed.
  - 11. Power supplies in luminaires mounted under a covered structure, such as a canopy, or where otherwise appropriate shall be UL listed with a sound rating of A.



12. Shall be dimmable, and compatible with a standard dimming control circuit of 0 - 10V or other approved dimming system.
13. Shall be equipped with over-temperature protection circuit that turns light source off until normal operating temperature is achieved.

## 2.06 LED LUMINAIRE SURGE PROTECTION

- A. Provide surge protection integral to luminaire to meet C Low waveforms as defined by IEEE C62.41.2, Scenario 1, Location Category C.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install luminaires as detailed on the drawings or to poles as directed.

### 3.02 INSTALLATION OF LIGHTING FIXTURES

- A. Install all lighting fixtures complete and ready for service, in accordance with the Fixture Schedule on the Drawings:
- B. Wire all fixtures with fixture wiring of at least 150 degree C rating.
- C. Install all fixtures straight and true with site equipment, sidewalks, etc.

### 3.03 ADJUSTING

- A. Section 260500 Contract Closeout

### 3.04 CLEANING

- A. Section 260500 - Contract Closeout: Cleaning installed work.
- B. Clean electrical parts to remove conductive and deleterious materials.
- C. Remove dirt and debris from enclosures.
- D. Clean photometric control surfaces as recommended by manufacturer.
- E. Clean finishes and touch up damage.

### 3.05 DEMONSTRATION AND INSTRUCTIONS

- A. Section 260500 - Contract Closeout - Starting of Systems: Demonstrating installed work.
- B. Demonstrate luminaire operation for 12 hours.

### 3.06 PROTECTION OF FINISHED WORK

- A. Re-lamp or repair luminaires that have failed at substantial completion.

### 3.07 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

### 3.08 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test after 100 hours of burn-in time to show that the equipment operates in accordance with the requirements of this section.

**END OF SECTION**

**SECTION 31 05 19**  
**GEOSYNTHETICS**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section covers the manufacturing and installation of geosynthetics including non-woven filter fabric.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 31 22 00 Site Grading
3. Section 31 23 15 Excavation and Backfill for Buried Pipelines

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text to by basic designation only.

- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- |                     |   |
|---------------------|---|
| 1. B16.1/ASTM D 751 | Standard Test Methods for Coated Fabrics  |
| 2. ASTM D 1777      | Standard Test Method for Thickness of Textile Materials   |
| 3. ASTM D 3786      | Standard Test Method for Bursting Strength of Textile Fabrics - Diaphragm Bursting Strength Tester Method |
| 4. ASTM D 4533      | Standard Test Method for Trapezoid Tearing Strength of Geotextiles  |
| 5. ASTM D 4632      | Standard Test Method for Grab Breaking Load and Elongation of Geotextiles                                 |
| 6. ASTM D 4751      | Standard Test Method for Determining Apparent Opening Size of a Geotextile                                |
| 7. ASTM D 4833      | Standard Test Method for Index Puncture Resistance of Geomembranes and Related Products                   |
| 8. ASTM D 5034      | Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)                  |
| 9. ASTM D 5035      | Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)                  |
| 10. ASTM D 5261     | Standard Test Method for Measuring Mass per Unit Area of Geotextiles                                      |

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Quality Control Certificates shall be provided at a minimum frequency of one (1) per every hundred thousand (100,000) square feet of geosynthetics produced consecutively, and which is supplied to the project. These certificates shall be supplied only for the

individual rolls of geosynthetics sampled and tested by the Manufacturer or his representative. An individual Quality Control Certificate shall be provided for each roll of geosynthetics provided to the project, which was not produced consecutively within the hundred thousand (100,000) square foot lot. Quality Control Certificates shall be submitted two (2) weeks prior to installation of geosynthetics and shall state that the geosynthetics meets the requirements of these specifications for:

1. Mass per Unit Area
  2. Grab Tensile Strength
  3. Mullen Burst Strength
  4. Equivalent Opening Size
- C. Geosynthetics shall not be accepted and/or incorporated into the project without the approved quality control documentation.
- D. Certification stating that all geosynthetics is furnished by one manufacturer shall be submitted two (2) weeks prior to installation.

## **1.5 DELIVERY, STORAGE AND HANDLING**

- A. Storage and handling of the geosynthetics shall be the responsibility of CONTRACTOR.
- B. During shipment, handling and storage, the geosynthetics shall be protected from ultraviolet light exposure, precipitation, or other inundation, mud, dirt, dust, puncture, cutting or any other damage or deleterious conditions. To that effect, geosynthetics rolls shall be shipped and stored in relatively opaque and watertight wrappings. An opaque tarp shall be placed over all rolls where the outer wraps are removed or damaged and where the geotextile is exposed. CONTRACTOR shall be responsible for the replacement of damaged or unacceptable materials at no cost to OWNER.
- C. Storage of Materials: A storage area shall be provided on site by OWNER. The storage of geosynthetic materials shall be the responsibility of CONTRACTOR until the completed installation is accepted by ENGINEER.
- D. Damaged Geosynthetics: Damaged geosynthetic materials shall be repaired, if possible, in accordance with these specifications, or shall be replaced at no additional cost to OWNER.

## **PART 2 PRODUCTS**

### **2.1 GEOSYNTHETICS (FILTER FABRIC)**

- A. The geosynthetics shall be 10-ounce (or heavier) non-woven filter fabric.
- B. Geosynthetics shall be provided in rolls.
- C. Each roll of geosynthetics shall be externally labeled or tagged to provide product identification sufficient for field determination as well as inventory and quality control purposes. Each roll shall be labeled with the name of manufacturer, roll number, physical dimensions (length and width) and the material type. Any roll of geosynthetics from which the labeling has been removed or has become illegible, shall not be used, but shall be removed from the site and replaced at the expense of CONTRACTOR.

- D. The geosynthetics shall be sampled, tested, and certified by the manufacturer for the following properties:

<b>MATERIAL PROPERTIES FOR NON-WOVEN GEOTEXTILE FILTER FABRIC</b>		
Property	Specification	ASTM Test Method
Mass per Unit Area (min)	10.0 oz./S.Y.	D-5261
Grab Tensile Strength (min)	250 lbs.	D-4632
Elongation at Break	50 %	D-4632
Tear Strength (min)	100 lbs	D-4533
Apparent Opening Size (maximum U.S. Sieve size)	100 mesh	D-4751

- E. Filter Fabric shall be **Mirafi 1100N by TenCate, 250NW by U.S. Fabrics**, or approved equal.

### **PART 3 EXECUTION**

#### **3.1 DEPLOYMENT**

- A. Prior to deployment, CONTRACTOR shall inspect each roll of geosynthetics to verify that the roll has a valid Quality Control Certificate and that has been previously approved by ENGINEER.
- B. Adjacent rolls shall be joined by overlapping the edges a minimum of twelve (12) inches.
- C. The overlap shall be glued, sewn or otherwise fastened or secured at intervals no greater than two feet along a line through the midpoint of the overlap. Additional fasteners shall be installed as necessary to prevent slippage of the geosynthetics regardless of location.
- D. CONTRACTOR shall visually inspect the geosynthetics during deployment for holes, tears or improperly formed geosynthetics. Defective areas shall be repaired or removed and replaced by CONTRACTOR at no additional cost to OWNER.
- E. Smoking shall not be permitted on the geosynthetics.
- F. CONTRACTOR shall be responsible to provide adequate loading (e.g., sand bags or similar items that will not damage the underlying geosynthetic) to prevent movement of the geosynthetics. Any damage to the geosynthetics shall be repaired at CONTRACTOR's expense.
- G. The geosynthetics shall not be exposed to the sun and elements for more than 72 hours unless the filter fabric has ultraviolet inhibitors. Fabric with ultraviolet inhibitors shall not be exposed for a period in excess of the manufacturer's recommendations, in which case manufacturer shall provide prior to product delivery.

- H. Any damage to the geosynthetics during installation or any fabric that has been exposed to the sun or elements for longer than the 72 hours, or as specified by the manufacturer, shall be replaced by CONTRACTOR at no additional cost to OWNER.
- I. CONTRACTOR shall be responsible to observe placement of geosynthetics. CONTRACTOR shall provide a daily inventory of all geosynthetics deployed to ENGINEER.

### **3.2 REPAIRS**

- A. Any holes, tears or defective areas in the geosynthetics shall be repaired by patching with same type of geosynthetics. The patch shall extend a minimum of twelve (12) inches in all directions beyond the area to be repaired. The patch shall be secured in place by gluing, sewing, or securing the fabric as per these specifications.

- END OF SECTION -

**SECTION 31 11 00**  
**CLEARING, GRUBBING, AND STRIPPING**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Work shall consist of removing and disposing of all trees; shrubs; brush; stumps; windfalls; roots; and other vegetation, including dead and decayed matter; and debris that exist within the designated construction limits, borrow areas, and soil stockpile areas and which are not specifically designated to remain.

**1.2 DEFINITIONS**

- A. Clearing: Clearing operations shall consist of cutting, removing and disposing of trees, shrubs, bushes, windfalls and other vegetation within the construction limits, borrow areas, and soil stockpile areas. All brush shall be cut off within six inches of the ground surface.
- B. Grubbing: Grubbing operations shall consist of removing and disposing of stumps, roots, debris deleterious materials, and other remains (such as organic and metallic materials) which if left in place would interfere with proper performance or completion of the contemplated work, would impair its subsequent use or form obstructions therein. Organic material from clearing or grubbing operations shall not be incorporated in fill or backfill.
- C. Stripping: Stripping operations shall consist of removing all soil material containing sod, grass, or other vegetation and topsoil to a minimum depth of six (6) inches from all areas that will receive fill or over all trenches in field or yard areas.

**PART 2 PRODUCTS (Not Used)**

**PART 3 EXECUTION**

**3.1 CLEARING**

- A. All trees, stumps, shrubs, bushes, windfalls and other vegetation (except such trees and vegetation as may be indicated or directed by ENGINEER to be left standing) shall be cut off to within six inches of the ground surface and shall be removed from the construction limits. Trees and vegetation to be left standing shall be protected from damage incident to clearing, grubbing, and construction operations by such means as the circumstances require.

**3.2 GRUBBING**

- A. All stumps, roots, debris, deleterious and other organic or metallic materials not suitable for foundations shall be removed completely from the construction limits, borrow areas and soil stockpile areas. Unless otherwise permitted by ENGINEER, stumps shall be removed completely. If any stumps are permitted to remain, they shall be cut off not more than six inches above the ground.

### **3.3 STRIPPING**

- A. Soil material containing sod, grass, or other vegetation and topsoil shall be removed to a minimum depth of six (6) inches from all areas to receive fill from the area within lines 5 feet outside all foundation walls, over all trenches, and from beneath pavement and curb and gutter areas. The stripped material shall be deposited in such locations as are acceptable to ENGINEER. Topsoil shall be placed over designated areas to be landscaped, and over all trench areas (outside of paved areas).
- B. All areas to be sodded shall have a minimum thickness of 3 inches (or thicker if required elsewhere in these documents or on the Contract Drawings) of topsoil.

### **3.4 DISPOSAL**

- A. Open burning of combustible materials will not be allowed.
- B. All trees, timber, stumps, roots, debris, shrubs, bushes, and other vegetation removed during the clearing and grubbing operations shall be removed from the project site and disposed of by CONTRACTOR subject to specific regulations imposed by laws and ordinances and in a manner that will not create a public nuisance nor result in unsightly conditions. CONTRACTOR shall assume full responsibility for acceptable disposition of the material as well as for any damages resulting from his disposal operations.

- END OF SECTION -



**SECTION 31 22 00**  
**SITE GRADING**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Work consists of site grading and related activities.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 45 00 Quality Control and Materials Testing
  2. Section 01 50 00 Temporary Construction Utilities & Environmental Controls
  3. Section 31 23 15 Excavation and Backfill for Buried Pipelines
  4. Section 31 23 23 Excavation and Backfill for Structures
  5. Section 32 11 23 Untreated Base Course

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of these Specifications to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>)
  2. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

**PART 2 PRODUCTS**

**2.1 EMBANKMENT MATERIAL**

- A. Embankment materials are defined as those complying with ASTM D2487, the Unified Soil Classification System (USCS) of CL, ML, SM, SC, SP, or combinations of these materials.
- B. Embankment material shall be free from frozen lumps, rocks larger than 6 inches in the larger dimension, roots, trash, lumber, or organic material. Suitability of material for embankment in accordance with these criteria will be as determined by ENGINEER.
- C. It is not anticipated that CONTRACTOR will be required to furnish additional quantities of embankment fill material from off-site sources to supplement material available from on-site excavations. However, if required, CONTRACTOR shall not borrow materials from adjacent private or public lands without providing to OWNER written verification of such approval from the appropriate landowner or agency. CONTRACTOR shall be responsible for all costs associated with providing additional quantities of embankment fill as may be required to complete the work described herein and as shown on the Contract Drawings.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Grading shall produce uniform grades or slopes between spot elevations or contours shown.
- B. Areas of construction activity shall be left in condition of uniform grade, blending into pre-existing contours and concealing, as much as possible, evidence of construction activity by back dragging or raking to conceal tire marks. Revegetation shall not be performed until the subgrade is acceptable to OWNER.
- C. Unless otherwise directed by OWNER, all excess excavated materials shall be removed from the site and disposed of by CONTRACTOR. CONTRACTOR shall restore stockpile area to pre-existing condition.

### **3.2 SITE PREPARATION**

- A. Prior to placement of embankment fill, loose or disturbed soil shall be removed and replaced with compacted structural fill, or disturbed soil shall be properly compacted.
- B. Prior to placement of embankment fill, the top 6-inches, or as noted on the Contract Drawings, of the subgrade shall be scarified and compacted to 95% minimum Modified Proctor density as determined by ASTM D 1557.
- C. Embankment shall include the placement of materials to raise the existing grade to the established elevations indicated and the construction of driving surfaces.
- D. Embankment material shall be placed in no more than 8-inch loose lifts for heavy equipment, and 4-inch loose lifts for hand operated equipment.
- E. All embankment fill material shall be placed and compacted to 96% minimum Modified Proctor Density as determined by ASTM D 1557. Embankment under roadways, to a minimum depth of four feet, shall be compacted to 96% minimum as determined by ASTM D 1557.
- F. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and recompacted to the minimum required compaction, unless recommended otherwise by the Soils Testing Agency, prior to placing any additional fill material.
- G. Unless otherwise specified, CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If the Soils Testing Agency should determine that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.

### **3.3 GRADING**

- A. The final grade of all completed areas shall be between plus and minus one-tenth ( $\pm 0.1$ ) of a foot from the grade designated on the Contract Drawings.

- END OF SECTION -

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**SECTION 31 22 16**  
**FINE GRADING**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. The Fine Grading Work, includes, but is not limited to:
  - 1. Perform fine grading work required to prepare site for landscape finish grading and soil preparation as described in Contract Documents.
  - 2. Furnishing of conditioner to stockpiled topsoil.

**1.2 RELATED WORK**

- A. Related work specified in other sections includes, but is not limited to:
  - 1. Section 32 91 13 Finish Grading and Topsoil Preparation

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text to by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>))

**1.4 QUALITY ASSURANCE**

- A. Pre-Installation Conference: Participate in pre-installation conference.

**PART 2 PRODUCTS - Not Used**

**PART 3 EXECUTION**

**3.1 PROTECTION**

- A. Do not commence work of this Section until site grading tolerances are met.
- B. Surface Preparation:
  - 1. Before placing topsoil, dig out weeds from planting areas by their roots and remove from site. Remove rocks larger than 1-inch in size and foreign matter such as building rubble, wire, cans, sticks, concrete, etc.
  - 2. Remove imported paving base material present in planting areas down to natural sub-grade or other material acceptable to ENGINEER.

### 3.2 PERFORMANCE

- A. Interface with Other Work: Do not commence work of this Section until site grading tolerances are met.
- B. Site Tolerances:
  - 1. Maximum variation from required grades shall be 1/10 of one foot.
  - 2. To allow for final finish grades of planting areas, sub-grade elevations in landscape areas, before placing topsoil are:
    - a. Shrub Areas: 15 ½ inches below top of walk or curb.
    - b. Sod Areas: 5 ½ inches below top of walk or curb.
- C. Do not expose or damage existing shrub or tree roots designated to remain.
- D. Distribute approved imported topsoil as required. Remove organic material, rocks, clods greater than 1-inch in any dimension, and other objectionable materials.
- E. Slope grade away from structure for 12 feet minimum from walls at slope of 1/2 inch in 12 inches minimum unless otherwise noted. Direct surface drainage in manner indicated on Drawings by molding surface to facilitate natural run-off of water. Fill low spots and pockets with specified fill material and grade to drain properly.

- END OF SECTION -

**SECTION 31 23 15**  
**EXCAVATION AND BACKFILL FOR BURIED PIPELINES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This item shall consist of excavating all pipeline trenches to the lines and grades indicated on the Contract Drawings or as directed by ENGINEER in the field, and the backfilling of all pipeline trenches. Excavation shall include the removal of all materials of whatever nature encountered to the depths shown on the Contract Drawings, or as modified in the Field by ENGINEER.

**1.2 RELATED SECTIONS**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 01 45 00 Quality Control & Materials Testing
  3. Section 01 45 01 Quality Control & Materials Testing (Supplement)
  4. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
  5. Section 31 23 19 Dewatering
  6. Section 32 11 23 Road Base - Untreated Base Course
  7. Section 33 05 05 Ductile Iron Pipe

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referred. The publications are referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
  2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
  3. T 88 Standard Method of Test for Particle Size Analysis of Soils
  4. T 96 Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
  5. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
  6. T 191 Standard Method of Test for Density of Soil In Place by the Sand Cone Method
  7. T 205 Density of Soil In-Place by the Rubber-Balloon Method
  8. T 238 Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  9. T 239 Moisture Content of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
  10. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

## C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. C 131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
2. C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
3. D 422 Standard Test Method for Particle Size Analysis of Soils
4. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup>)
5. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
6. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft<sup>3</sup>)
7. D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity -Flow Applications
8. D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
9. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

## 1.4 DEFINITIONS

- A. Degree of Compaction: Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.
- B. Pipe Zone: That zone in an Excavation which supports, surrounds, and extends to 12 inches above the top of the pipe barrel. Specifically, 6 inches below the bottom (where rock, hard pan, boulders, etc. are encountered), 12 inches above the top of the pipe, and 1 foot laterally beyond both sides of the pipe, unless noted otherwise on the Contract Drawings.
- C. Trench Zone Backfill: That zone in an Excavation which begins 12 inches above the top of the pipe barrel and extends to the natural surface level or the finished grade indicated on the Plans.
- D. Unyielding Material: Unyielding material shall consist of rock and gravelly soils with stones greater than 12 inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.
- E. Unstable Material: Unstable material shall consist of materials too wet to allow backfill compaction or to properly support the utility pipe, conduit, or appurtenant structures.
- F. Rock: Solid mineral material which cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling, or blasting. Minimum equipment size, in good running order, shall be similar to a **Komatsu 300, Caterpillar 320 or 330**, or equal.

## 1.5 SUBMITTALS

- A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:



1. Copies of Field Density Test reports shall be submitted to ENGINEER at the beginning of each workday for the previous day's testing of subgrades, embankments and backfill Materials.
2. Copies of all Laboratory Test Reports shall be submitted to ENGINEER within 24 hours of the completion of the test.
3. Submit gradations and proctors for Pipe Zone Material and Trench Zone Backfill.
4. Excavation Protection Plan: Describe sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property; include structural calculations to support plan.

## **1.6 SITE CONDITIONS**

- A. Unsuitable Weather Limitations: CONTRACTOR shall not place, spread, or roll any fill material during unsuitable weather conditions. CONTRACTOR shall not resume operations until moisture content of material is satisfactory.
- B. Weather Softened Subgrade: CONTRACTOR shall remove and replace at no additional cost to OWNER soft subgrade materials resulting from adverse weather conditions.
- C. Protection of Graded Areas: CONTRACTOR shall protect all graded areas from traffic and erosion and shall keep these areas free of trash and debris. Work required to repair and reestablish grades in settled, eroded, and rutted areas shall be completed to specified tolerances at CONTRACTOR's expense.
- D. Reconditioning Compacted Areas: All areas compacted to required specifications that become disturbed by subsequent construction operations or weather conditions shall be scarified, moisture conditioned, and re-compacted to the required density prior to further construction.
- E. Grading: the final compacted surface of base course shall not vary more than 1/4 inch above or below design grade.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. Stabilization Material: Stabilization material shall consist of hard, durable particles of stone or gravel, screened, or crushed to the required size and gradation. The material shall be free from vegetation matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradation when tested in accordance with AASHTO T 27 or ASTM C 136.
  1. Coarse material shall be crushed or washed, and fine material shall be wasted to meet the grading requirements set forth below. Note that if stabilization material is required, an 8 oz. non-woven filter fabric shall be placed between the stabilization material and the pipe zone material.

2. Coarse aggregate, retained on the No. 4 sieve, shall have a percentage of wear not greater than 40 percent when tested by the Los Angeles Test, AASHTO T-96 or ASTM C 131.

<u>Sieve Size (Square Opening)</u>	<u>Percent By Weight Passing Screen</u>
2-inch	100
1-1/2 inch	10 - 50
3/4-inch	0 - 25
No. 4	0 - 10
No. 200	0 - 3

- B. Pipe Zone Material: All material in the pipe zone shall be clean and free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of the ENGINEER may be objectionable or deleterious. "Squeegee" or any other flowable material shall not be permitted. Pipe zone material shall conform to the following:
  1. Waterline and Drain Pipes – 3/4-inch Untreated Base Course per Section 32 11 23.
  2. Waterline – Controlled Low-Strength Material (Flowable Fill):
    - a. Flowable Fill shall be per APWA Section 03 31 05 – Controlled Low Strength Material.
- C. Select Trench Backfill: Select backfill shall consist of native or imported materials (soils or bedrock which can be broken down to a compactible size). Maximum particle size for backfill shall be no greater than 4-inches. Select backfill shall be capable of meeting the compaction requirements.
- D. Native Trench Backfill: Trench backfill may consist of native fill material meeting soils classifications A-1-a for Granular Borrow material of AASHTO M 145 or APWA Section 31 05 13, with a maximum particle size no greater than 2-inches in any dimension and shall be capable of meeting the compaction requirements. Trench backfill shall be non-plastic. Trench backfill shall be free from alkali, salt, petroleum products, vegetative matter or other deleterious matter, slag, cinders, ashes and rubbish or other material that in the opinion of ENGINEER may be objectionable or deleterious. "Squeegee" or any other flowable material shall not be permitted.
- E. Imported Granular Trench Backfill: At the direction of OWNER where native materials are unable to achieve satisfactory compaction or meet the required soils classification, imported granular trench backfill shall be used and shall consist of imported materials meeting soils classifications A-1-a for Granular Borrow material of AASHTO M 145 or APWA Section 31 05 13 and shall be non-plastic. The maximum particle size for backfill shall be no greater than 2 inches. Imported granular trench backfill shall be capable of meeting the compaction requirements.

## **PART 3 EXECUTION**

### **3.1 EXCAVATION**

- A. Excavation shall be performed to the lines and grades indicated. All excavated materials not intended for reuse shall be removed from the site and disposed of by the Contractor.
- B. Rock Removal
  - 1. CONTRACTOR shall cut away Rock at excavation bottom to form level bearing.
  - 2. All shaled layers shall be removed to provide sound and unshattered base for foundations.
  - 3. CONTRACTOR shall remove and legally dispose of excess excavated material and debris off-site unless indicated otherwise.
  - 4. CONTRACTOR shall correct unauthorized Rock removal at no additional cost to OWNER.

### **3.2 SAFETY**

- A. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable State safety requirements and the latest requirements of OSHA Safety and Health Standards for Construction (29 CFR 1926). CONTRACTOR is responsible for assessing safety needs to meet such requirements, arranging for proper equipment and/or construction methods, and maintaining such equipment, methods, and construction practices so as to fully comply with all safety requirements.
- B. CONTRACTOR is responsible for assessing needs related to confined space entry, as defined by OSHA. CONTRACTOR shall meet all such requirements, arranging for proper equipment and/or construction methods, and maintaining such equipment, methods and construction practices so as to fully comply with all confined space safety requirements.

### **3.3 DEWATERING**

- A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

### **3.4 TRENCH WIDTH**

- A. The bottom of the trench shall have a minimum width equal to the outside diameter of the pipe plus 24-inches or as detailed on the Contract Drawings.
- B. The width of the trench shall be ample to permit the pipe to be laid and jointed properly, and the backfill to be placed and compacted as specified. Trenches shall be of such extra width, when required, as will permit the convenient placing of timber supports, sheeting, and bracing, and the handling of special units as necessary.

### **3.5 TRENCH PREPARATION**

- A. Each trench shall be excavated so that the pipe can be laid to the alignment and grade as required. The trench wall shall be so braced that the workmen may work safely and

efficiently. All trenches shall be drained so the pipe laying may take place in dewatered conditions.

**B. Bottom Preparation**

1. Where rock, hard pan, boulders or other material which might damage the pipe are encountered, the bottom of the trench shall be over excavated 12 inches below the required grade and replaced with Stabilization Material. Otherwise, the bottom of the trench shall be over excavated 6 inches or 1/12 the outside diameter of the pipe, whichever is greater, below the required grade and replaced with Pipe Zone Backfill.
2. The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 1-inch or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

**C. Removal of Unstable Material**

1. Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed by ENGINEER and replaced to the proper grade with Stabilization Material. When removal of unstable material is required due to the fault or neglect of CONTRACTOR in his performance of the work, the resulting material shall be excavated and replaced by CONTRACTOR without additional cost to OWNER.

- D.** The trench bottom (at the level of the base of the pipe) shall be given a final trim using a string line, laser, or another method approved by ENGINEER for establishing grade, such that each pipe section when first laid will be continually in contact with the ground along the extreme bottom of the pipe. Bell holes shall be provided at each joint to permit the jointing to be made properly. The trench grade shall permit the pipe spigot to be accurately centered in the preceding laid pipe joint, without lifting the pipe above the grade, and without exceeding the permissible joint deflection.

**3.6 SHEETING AND SHORING**

- A.** Sheet, shore, and brace excavations to prevent danger to persons, structures, and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B.** Support trenches excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C.** Design sheeting and shoring to be removed at completion of excavation work.
- D.** Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E.** Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

### **3.7 LAYING AND JOINING PIPE**

- A. Laying pipe: Provide proper facilities for lowering pipe sections into place. Dropping pipe will not be permitted. Place each section true to line and gradient in close and true contact with adjacent sections.
- B. Joining pipe:
  - 1. Use methods of joining conduit sections ensuring ends are fully entered and inner surfaces are flush and even. The equipment used to force the joints together must be adequate to overcome the gasket pressure involved. Pipe shall be installed in accordance with these specifications and the manufacturers' written specifications.
  - 2. Just prior to joining the pipes, both spigot and bell ends shall be thoroughly cleaned to remove all foreign substances which may have adhered to the bell and spigot surfaces. All dust and dirt shall be removed with a clean rag. An approved lubricant (recommended by the manufacturer), that is not injurious to the gasket, shall be applied in accordance with the manufacturer's recommendations.
  - 3. In the event any foreign material becomes embedded in the lubricant, or the lubricant becomes contaminated by water or other substances before the joint is started, the area affected shall be re-cleaned and new lubricant applied.
  - 4. The pipe being joined shall be carefully moved into position, line and grade checked, and, as the spigot end is started into the bell of the section previously laid, the gasket shall be checked to insure uniform entry into the bell at all points. Align the spigot to the bell and insert the spigot into the bell until it contacts the gasket uniformly. Apply firm steady pressure either by hand or by bar and block assembly, until the spigot easily slips through the gasket. Care must be taken to ensure that the spigot is not over-inserted and that previously assembled pipe joints are not disturbed.

### **3.8 PIPELINE TRENCH BACKFILLING AND COMPACTION**

- A. Pipe Zone:
  - 1. Pipe Zone Backfill shall be placed in layers not exceeding 6 inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Each layer shall be compacted to at least 95 percent of the maximum Modified Proctor density (ASTM D 1557), unless otherwise specified.
  - 2. Replacement of Unyielding Material: Unyielding material removed from the bottom of the trench shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.
  - 3. Replacement of Unstable Material: Unstable material removed from the bottom of the trench or excavation shall be replaced with Stabilization Material placed in layers not exceeding 6 inches loose thickness.
  - 4. Where the pipe grade exceeds 30%, cohesive material shall be used in lieu of pipe bedding. The cohesive material shall be moistened to within 2% of optimum moisture and compacted as noted.
  - 5. The relative density of the compacted cohesionless material shall not be less than 60% as determined by the Bureau of Reclamation Relative Density of Cohesionless Soil Test (Designation E-12) of the "Earth Manual."

B. Trench Backfill: Trenches shall be backfilled to the grade shown with Trench Backfill material as specified.

1. Trench backfill in asphalted road shall consist of backfilling the trench from above the pipe zone up to underneath the noted recommended depth for untreated base course and asphalt or concrete of finished grade with Trench Backfill material compacted to a minimum 96 percent of maximum density (ASTM D-1557). Backfill shall be placed in layers not exceeding 6-inches loose thickness for compaction by hand operated machine compactors, and 8 inches loose thickness for other than hand operated machines, unless otherwise approved or specified.
2. Trench backfill in unimproved or landscaped areas shall consist of backfilling the trench from above the pipe zone to 8-inches below finished grade with Trench Backfill material compacted to 90 percent of maximum density (ASTM D-1557). Backfill from 8-inches below finished grade to finished grade shall consist of topsoil replacement in addition to replacement of all landscaped materials. Trench backfill shall be placed in layers not exceeding 8 inches loose thickness.
3. It shall be the responsibility of CONTRACTOR to be assured that the Trench Backfill material is capable of being compacted to the degree specified. It shall be CONTRACTOR's responsibility to remove and dispose of all excess excavated material.

C. Final Backfill:

1. Unimproved and Landscaped Areas: The top 8-inches of the trench shall be filled with topsoil. Topsoil may be native material stripped prior to excavation of the trench. Backfill shall be deposited in layers of a maximum of 12-inch loose thickness and compacted to a minimum of 85 percent maximum density (ASTM D-1557). Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.
2. Roadways shall be completed with the type and thickness of materials (i.e., Untreated Road Base and Asphalt) as indicated or shown on the Contract Drawings

### **3.9 SPECIAL REQUIREMENTS**

A. Special requirements for both excavation and backfill relating to the specific utilities from above the pipe zone to the natural surface level or the finished grade indicated on the Plans shall be placed and compacted as follows:

1. Where existing underground pipes or conduits larger than 3-inches in diameter and all sizes of sewer lines or sewer laterals cross the trench above the new work, the backfill from the bottom of the trench to 1 foot above the top of the intersecting pipe or conduit shall be pipe zone material compacted to 96 percent of maximum density (ASTM D-1557). The pipe zone material shall extend 2 feet on either side of the intersecting pipe or conduit to ensure that the material will remain in place while other backfill is placed.

B. The maximum trench length open at any given time shall not exceed 200 feet unless approved by ENGINEER and must be backfilled in a timely manner.

### **3.10 MAINTENANCE OF BACKFILL**

- A. All backfill shall be maintained in satisfactory condition, and all places showing signs of settlement shall be filled and maintained during the life of the Contract and for a period of one year following the day of final acceptance of all work performed under the Contract. When CONTRACTOR is notified by ENGINEER or OWNER that any backfill is hazardous, CONTRACTOR shall correct such hazardous condition at once. Any utility, road and/or parking surfacing damaged by such settlement shall be repaired by CONTRACTOR to the satisfaction of OWNER and ENGINEER. In addition, CONTRACTOR shall be responsible for the cost to OWNER of all claims for damage filed with the Court, actions brought against the said OWNER for, and on account of, such damage.

### **3.11 FINISH GRADING AND CLEANUP**

- A. CONTRACTOR shall grade the trench line to a smooth grade to affect a neat and workmanlike appearance of the trench line.
- B. All tools, equipment and temporary structures shall be removed. All excess dirt and rubbish shall be removed from the site by CONTRACTOR.
- C. CONTRACTOR shall restore the site to at least as good as original condition, including but not limited to final trench grade and restoration of affected public and private facilities whether in the public right-of-way or on private property. Any exception to this requirement must be in writing from ENGINEER for the job specific conditions.

### **3.12 COMPACTION TESTS**

- A. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, fill, and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.
  - 1. Testing of Backfill Materials
    - a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00 - Quality Control & Materials Testing.
    - b. The CONTRACTOR shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
      - i) 50 linear feet of trench backfill.
    - c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
    - d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.
    - e. Compliance tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to CONTRACTOR.

- f. ENGINEER may require retesting of backfill that has settled from water penetration in the trench. CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to the OWNER.
  - g. If compaction fails to meet the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid by CONTRACTOR. CONTRACTOR's confirmation tests shall be performed in a manner acceptable to ENGINEER.
2. Field Density Tests
- a. Field density tests shall be made in accordance with ASTM D 1557.

- END OF SECTION -



**SECTION 31 23 17**  
**ROCK EXCAVATION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This work shall consist of the requirements for Rock removal and the use of explosives (only by written permission by ENGINEER and/or OWNER) to assist in Rock removal.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures

**1.3 DEFINITIONS**

- A. Rock: Solid mineral material which cannot be removed with equipment reasonably expected to be used in the Work without cutting, drilling or blasting. Minimum equipment size, in good running order, shall be similar to a Komatsu 300, Caterpillar 320 or 330, or equal.

**1.4 REFERENCES**

- A. NFPA 495: Code for the Manufacture, Transportation, Storage and Use of Explosive Materials.
- B. UOSH Construction Standards Chapter U: Blasting and the Use of Explosives

**1.5 SUBMITTALS**

- A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:
  - 1. Proposed method of blasting, delay pattern, explosive types, type of blasting mat cover, and intended rock recovery method.
  - 2. Photographs of existing site conditions and facilities in vicinity of Work prior to blasting.

**1.6 QUALITY ASSURANCE**

- A. Seismic Survey firms utilized shall be specialized in seismic survey and have a minimum 2 years documented experience.
- B. Explosive firms shall be specialized in explosives for disintegration of Rock with at least 2 years documented experience.

**PART 2 PRODUCTS**

## **2.1 EXPLOSIVES**

- A. Explosives shall be of the recommended type by an explosive firm following seismic survey and required by authorities having jurisdiction.
- B. Delay devices shall be as recommended by the explosive firm.
- C. Blasting Mat Materials shall be as recommended by the explosive firm.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

- A. CONTRACTOR shall verify site conditions and note irregularities affecting work of this SECTION.
- B. CONTRACTOR shall be responsible for and obtain all permits from authorities having jurisdiction before explosives are brought to site or drilling is started.
- C. CONTRACTOR shall locate and protect all utilities.
- D. The beginning of work of this Section constitutes acceptance of existing conditions.
- E. All work must comply with NFPA 495.

### **3.2 STORAGE OF BLASTING MATERIALS**

- A. Securely store all explosives in compliance with Laws and Regulations.
- B. Mark all storage places clearly.
- C. Where no local Laws or Regulations apply, CONTRACTOR shall provide storage not closer than 1,000 feet from any road, building, camping area or place of human occupancy.

### **3.3 ROCK REMOVAL - NONEXPLOSIVE METHOD**

- A. CONTRACTOR shall cut away Rock at excavation bottom to form level bearing.
- B. All shaled layers shall be removed to provide sound and unshattered base for foundations.
- C. CONTRACTOR shall remove and legally dispose of excess excavated material and debris off-site unless indicated otherwise.

### **3.4 ROCK REMOVAL - EXPLOSIVE METHOD**

- A. CONTRACTOR shall comply with UOSH Construction Standards Chapter U rules and regulations.
- B. CONTRACTOR shall provide a qualified explosive expert to act as an advisor and consultant during drilling and blasting operations.

- C. All owners with adjacent buildings or structures and utility companies shall be notified in writing prior to setting up seismographics. The notice shall describe blasting and seismic operations.
- D. CONTRACTOR shall obtain and pay for a seismic survey prior to Rock excavation to determine maximum charges that can be used at different locations in area of excavation without damaging adjacent properties and utilities.
- E. Seismograph monitoring shall continue during progress of blasting operation.
- F. Any excess rock designated by ENGINEER shall be disintegrated or removed from excavation operations and legally disposed of unless indicated otherwise.

### **3.5 FIELD QUALITY CONTROL**

- A. CONTRACTOR shall visually inspect bearing surfaces and cavities formed by removed Rock. All voids shall be filled and compacted as required elsewhere in the specifications.

-                   END                   OF                   SECTION                   -

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**SECTION 31 23 19**  
**DEWATERING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This Section provides specifications for dewatering systems and appurtenances to be used during construction as required to remove water and continuously maintain groundwater at a level at least 1-foot below the bottom of the excavation.
- B. CONTRACTOR shall obtain all necessary permits for disposal of water removed from the excavation.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures

**1.3 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Before dewatering is commenced, CONTRACTOR shall provide information to ENGINEER outlining the method, installation and details of the proposed dewatering system. CONTRACTOR shall provide ENGINEER with plans setting forth details of the proposed dewatering systems. The dewatering system plans shall be of sufficient detail to indicate sizes of pumps, piping, appurtenances, the ultimate disposal point for water, and to indicate the overall completeness and effectiveness of the proposed system.
- C. CONTRACTOR shall certify to OWNER that the design and implementation of the proposed dewatering system is sufficient to complete the Work.
- D. Submit a plan to monitoring settlement of adjacent structures.

**1.4 QUALITY CONTROL**

- A. CONTRACTOR shall be responsible to control the rate and effect of dewatering to avoid all settlement and subsidence.
- B. Where critical structures exist immediately adjacent to areas of proposed dewatering, reference points shall be established and observed at frequent intervals to detect any settlement which may develop. CONTRACTOR is responsible for protecting adjacent structures from settlement. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of CONTRACTOR.

**PART 2 PRODUCTS**

**2.1 MATERIALS**

- A. CONTRACTOR shall be responsible for selection of dewatering means, methods and materials.

- B. Standby pumping equipment shall be maintained on the Site.

## **PART 3 EXECUTION**

### **3.1 DESIGN AND IMPLEMENTATION**

- A. CONTRACTOR shall be responsible for complete design and implementation of the dewatering system.
- B. CONTRACTOR shall be responsible for the design and implementation of any modifications that may be required to the initial design of the dewatering system (at no additional cost to OWNER) to provide a dewatering system that operates adequately to complete the Work.
- C. CONTRACTOR shall furnish, install, operate and maintain all machinery, appliances, and equipment to maintain all excavations free from water during construction.
- D. CONTRACTOR shall dispose of water so as to not cause damage to public or private property, or to cause a nuisance or menace to the public or violate the law.
- E. CONTRACTOR shall be responsible to obtain General Construction Dewatering discharge permits, if required.
- F. CONTRACTOR shall install and operate the dewatering system so as to not cause damage or endanger adjacent structures or property.
- G. The control of groundwater shall be such that softening of the bottom of excavations, or formation of "quick" conditions or "boils," does not occur. Dewatering systems shall be designed and operated so as to prevent removal and migration of the natural soils.
- H. CONTRACTOR shall have sufficient stand-by equipment at the project site at all times to continuously maintain the dewatering program until Work necessitating dewatering is complete.
- I. CONTRACTOR shall have on hand equipment and machinery in good working condition for emergencies and shall have personnel available for operation of such equipment and machinery.
- J. CONTRACTOR shall control surface water to prevent entry into excavations.

- END OF SECTION -

**SECTION 31 23 23**  
**EXCAVATION AND BACKFILL FOR STRUCTURES**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This section covers excavating, backfilling, and compacting of disturbed areas for structures and roadways as directed by ENGINEER.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 01 45 00 Quality Control and Materials Testing
  3. Section 01 45 01 Quality Control and Materials Testing (Supplement)
  4. Section 01 45 23 Testing Agency Services
  5. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
  6. Section 31 11 00 Clearing, Grubbing and Stripping
  7. Section 31 23 15 Excavation and Backfill for Buried Pipelines
  8. Section 31 23 19 Dewatering

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referred. The publications are referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. M 145 Standard Specification for Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
  2. T 27 Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
  3. T 88 Standard Method of Test for Particle Size Analysis of Soils
  4. T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
  5. T 191 Standard Method of Test for Density of Soil In Place by the Sand Cone Method
  6. T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. D 422 Standard Test Method for Particle Size Analysis of Soils
  2. D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft<sup>3</sup>)
  3. D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
  4. D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb/ft<sup>3</sup>)

- 5. D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- 6. D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D. The latest Edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction.
- E. The latest Edition of the American Public Works Association (APWA) and Associated General Contractors of America Standard Plans and Standard Specifications.

#### **1.4 SUBMITTALS**

- A. The following shall be submitted in accordance with Section 01 33 00 Submittal Procedures:
  - 1. Submit gradations and proctors for structural fill materials and backfill materials.

### **PART 2 PRODUCTS**

#### **2.1 WALL BACKFILL MATERIAL**

- A. Wall backfill material shall consist of native or import fill material meeting soils classifications A-1, A-2 or A-3 of AASHTO M 145, with a maximum particle size no greater than 6 inches in any dimension and shall be capable of meeting the compaction requirements.
  - 1. Wall backfill material shall be free from frozen lumps, rocks larger than 6 inches in the largest dimension, roots, trash, lumber and organic material.

#### **2.2 STRUCTURAL FILL**

- A. Structural fill material shall meet the following requirements. The existing fill and natural soil may be considered for use as structural fill if they meet the recommendations given above for imported structural fill and if the organics, debris, oversized particles and other deleterious materials are removed.
  - 1. Material shall be non-expansive granular soil with less than 35 percent passing the No. 200 sieve, with a liquid limit less than 30, and free from rocks larger than 4 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. The natural soils may be used as structural fill where it meets the above stated criteria.

#### **2.3 FLOOR SLAB FILL (Upper 4 inches)**

- A. Material shall be non-expansive granular soil with less than 5 percent passing the No. 200 sieve, and free from rocks larger than 2 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. The natural soils may be used as fill for the first 4 inches directly under the slab where it meets the above stated criteria.

#### **2.4 FLOOR SLAB**

- A. Material shall be non-expansive granular soil with less than 50 percent passing the No.



200 sieve, with a liquid limit less than 30, and free from rocks larger than 6 inches in the largest dimension, frozen lumps, roots, trash, lumber and organic material. The natural soils may be used as fill below the first 4 inches under the slab where it meets the above stated criteria.

## **2.5 3/4" WASHED ROCK**

- A. 3/4" Washed Rock shall consist of hard, durable particles of stone or gravel, screened or crushed, to the required size and gradation. The material shall be free from vegetation matter, lumps or balls of clay, or other deleterious matter and shall conform to the following gradation when tested in accordance with AASHTO T 27 or ASTM C 136.

<u>Sieve Size (Square Opening)</u>	<u>Percent By Weight Passing Screen</u>
3/4-inch	100
3/8 inch	78-92
No. 4	0 - 50
No. 8	0 - 5
No. 200	0 - 3

## **PART 3 EXECUTION**

### **3.1 EXCAVATION**

- A. Excavation shall be performed to the lines and grades indicated. Excavated material not required or not satisfactory for backfill shall be removed from the site.
- B. Excavations shall be braced and supported as needed to prevent the ground adjacent to the excavation from sliding or settling. Slides shall be promptly removed and corrected by CONTRACTOR.

### **3.2 PREPARATION**

- A. Approximately 4 to 6 feet of fill was encountered in the area of the proposed pump station. Unsuitable fill, topsoil, organics and other deleterious materials should be removed from below areas of proposed buildings, exterior slabs, pavement and other improvements sensitive to differential settlement Compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with granular fill and compact to density equal to or greater than requirements for subsequent fill material.
- C. Scarify subgrade surface to depth of 6 inches.

### **3.3 DEWATERING**

- A. Water removal shall be in accordance with Section 31 23 19 - Dewatering.

### **3.4 BACKFILL**

- A. Backfill material shall not be placed against concrete structures that have not been properly cured. No backfill material shall be placed until concrete has cured for a minimum of 7 days or until the compressible strength is 3,400 psi, whichever is greater.
- B. Backfill material shall be placed in no more than 6-inch loose lifts for compaction by hand operated machine compactors, and 8 inches loose lifts for other than hand operated machines.
- C. Structural fill placed beneath foundations, footings or the floor slab shall be placed and compacted to at least 96% of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D 1557.
- D. Backfill material shall be placed and compacted to at least 95 percent of maximum dry density at a moisture content within 2 percent of optimum moisture content in accordance with ASTM D-1557.
- E. Where the moisture content is not suitable and/or sufficient compaction has not been obtained, the fill shall be reconditioned to an approved moisture content and re-compacted to the minimum required compaction prior to placing any additional fill material.
- F. CONTRACTOR shall be responsible for arranging for the placing and compacting of approved fill material in accordance with these Specifications. If it is determined that CONTRACTOR is failing to meet the minimum requirements, CONTRACTOR shall stop operations and make adjustments as necessary to produce a satisfactorily compacted fill at no additional cost to OWNER.
- G. Sufficient personnel, equipment, sumps or other means should be provided to maintain the site in an acceptable dry condition for the duration of this contract.
- H. Excavations shall be so braced and supported as needed to prevent the ground, adjacent to the excavation, from sliding or settling. Localized slides or settlements shall be promptly removed and corrected by CONTRACTOR.

### **3.5 FINISHED GRADE**

- A. The finished subgrade and grade of the fill shall not vary more than 0.05 feet from the established grades and cross sections shown on the Contract Drawings.

### **3.6 COMPACTION TESTS**

- A. Compaction testing shall be the provided and paid for in accordance with Section 01 45 00 – Quality Control and Materials Testing.
- B. It shall be the responsibility of CONTRACTOR to accomplish the specified compaction for backfill, structural fill, Untreated Base Course and other earthwork. It shall be the responsibility of CONTRACTOR to control his operations by performing any additional tests necessary to verify and confirm that CONTRACTOR has complied, and is complying at all times, with the requirements of these Specifications concerning compaction, control, and testing.

1. Testing of Backfill Materials
    - a. Characteristics of backfill materials shall be determined in accordance with the requirements of Section 01 45 00.
    - b. Contractor shall demonstrate the adequacy of compaction equipment and procedures before exceeding any of the following amounts of earthwork quantities:
      - 1) One (1) test per 1.0 feet of backfill thickness placed per structure.
    - c. Until the specified degree of compaction on the previously specified amounts of earthwork is achieved, no additional earthwork of the same kind shall be performed.
    - d. After satisfactory conclusion of the initial compaction demonstration and at any time during construction, earthwork which does not comply with the specified degree of compaction shall not exceed the previously specified quantities.
    - e. Quality Control tests may be made by ENGINEER to verify that compaction is meeting the requirements previously specified at no cost to CONTRACTOR. If ENGINEER requires retesting of backfill, CONTRACTOR shall remove the overburden above the level at which ENGINEER wishes to test and shall backfill and recompact the excavation after the test is complete at no additional cost to OWNER.
    - f. If compaction fails to meet the specified requirements, CONTRACTOR shall remove and replace the backfill at proper density or shall bring the density up to specified level by other means acceptable to ENGINEER. Subsequent tests required to confirm and verify that the reconstructed backfill has been brought up to specified density shall be paid in accordance with Section 01 45 23 – Testing Agency Services. The confirmation tests shall be performed in a manner acceptable to ENGINEER. Frequency of confirmation tests for remedial work shall be double that amount specified for initial confirmation tests.
  2. Field Density Tests
    - a. Tests shall be performed in sufficient numbers to meet the requirements of Section 01 45 01 and to ensure that the specified density is being obtained.
- C. Field density tests shall be made in accordance with ASTM D 1557 and ASTM D 6938.

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**SECTION 32 11 23**  
**ROAD BASE – UNTREATED BASE COURSE**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This Work consists of the placement of Sub-Base and Untreated Base Course (UBC) material at designated roadways and all driving surfaces as indicated on the Contract Drawings.

**1.2 RELATED SECTIONS**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 01 45 00 Quality Control and Materials Testing

**1.3 REFERENCES**

- A. The latest edition of the following publication forms a part of this Specification to the extent referenced. The publication is referred to in the text by basic designation only.
- B. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)
1. AASHTO T 88 Standard Method of Test for Particle Size Analysis of Soils
  2. AASHTO T 180 Standard Method of Test for Moisture Density Relations of Soils Using a 10 lb. (4.54 kg) Rammer and an 18 in (457 mm) Drop
  3. AASHTO T 191 Standard Method of Test for Density of Soil In-Place by the Sand Cone Method
  4. AASHTO T 310 Standard Specification for In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Methods. (Shallow Depth)
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM D 422 Standard Method for Particle Size Analysis of Soils
  2. ASTM D 698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup>)
  3. ASTM D 1556 Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone method
  4. ASTM D 1557 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup>)
  5. ASTM D 2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
  6. ASTM D 6938 Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
- D. The latest edition of the Utah Department of Transportation Standard Specification for Road and Bridge Construction (UDOT).

## 1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Untreated Base Course (State approved 1-1/2" gradation, APWA Grade 1 or Grade 3/4).

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. Untreated Base Course: Untreated Base Course Materials shall meet the APWA Specifications for Grade 1 or Grade 3/4 as shown in Table 32 11 23-1.

**TABLE 32 11 23-1**

<b>SIEVE SIZE</b>	<b>MASTER GRADING BAND LIMITS (PERCENT PASSING)</b>	<b>GRADE 1 GRADATION (PERCENT PASSING)</b>	<b>GRADE 3/4 GRADATION (PERCENT PASSING)</b>
1 1/2 inch	100	-	-
1 inch	90-100	100	-
3/4 inch	70-85	-	100
1/2 inch	65-80	79 - 91	-
3/8 inch	55-75	-	78 -92
No. 4	40-65	49 - 61	55 - 67
No. 16	25-40	27 - 35	28 - 38
No. 200	7-11	7 - 11	7 - 11

## PART 3 EXECUTION

### 3.1 SUBGRADE PREPARATION

- A. Prior to placement of untreated base course materials, the foundation area to receive untreated base course materials shall be scarified to a minimum depth of 8-inches and recompact to 95% minimum laboratory density as determined by ASTM D1557.

### 3.2 UNTREATED BASE COURSE MATERIAL PLACEMENT

- A. No Untreated Base Course material shall be placed on sub-grade materials until the sub-grade has been checked and accepted by ENGINEER.
- B. Road base material placed on driving surfaces shall be compacted to a minimum density of 96% in accordance with ASTM D 1557 to provide a uniform graded smooth surface.
- C. Untreated Base Course material shall be placed to a minimum thickness eight (8) inches or as shown on the Contract Drawings.

### **3.3 FIELD QUALITY CONTROL**

- A. CONTRACTOR shall be responsible for directing proper placement of all road base materials. CONTRACTOR shall be responsible for the stability of the road base materials during placement and shall replace any portions which have become displaced due to careless or negligent work on the part of CONTRACTOR, or to damage resulting from natural causes, such as storms.
- B. Whenever the work areas to receive Sub-Base and/or Untreated Base Course material are covered with snow, the snow must be removed prior to placing the road base and/or Untreated Base Course and deposited outside the immediate construction areas at CONTRACTOR's expense.

- END OF SECTION -

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**SECTION 32 31 13**  
**GALVANIZED CHAIN LINK FENCES AND GATES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This section covers the furnishing of labor, materials and appurtenances necessary for installation of the galvanized chain link fence system defined herein. The manufacturer shall provide a total fence system including all components, panels, posts, gates, and hardware required.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 03 30 00 Cast-in-Place Concrete

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specifications to the extent referenced. The publications are referred to in the text to by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 121 Standard Specification for Metallic-Coated Carbon Steel Barbed Wire
  - 2. ASTM A 392 Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric
  - 3. ASTM A 780 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
  - 4. ASTM A 824 Standard Specification for Metallic-Coated Steel Marcellled Tension Wire for Use with Chain Link
  - 5. ASTM F 552 Standard Terminology Relating to Chain Link Fencing
  - 6. ASTM F 567 Standard Practice for Installation of Chain Link Fence
  - 7. ASTM F 626 Standard Specification for Fence Fittings
  - 8. ASTM F 900 Standard Specification for Industrial and Commercial Swing Gates
  - 9. ASTM F1083 Standard Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Shop drawings: Site plan showing layout of fence location with dimensions, location of gates and opening size, cleared area, elevation of fence, gates, footings and details of attachments.
- C. Certifications: Manufacturers material certifications in compliance with the current ASTM specifications.

- D. Domestic certifications: Material certifications, made in U.S.A., Buy American Act or Buy America when required.
- E. Material samples: When required, provide representative samples of chain link fabric, framework and fittings.

### **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

### **1.6 QUALITY ASSURANCE**

- A. Manufacturer: Company headquartered in the United States having U.S. manufacturing facility/facilities specializing in manufacturing chain link fence products with at least 5 years' experience.
- B. Fence contractor: Company with demonstrated successful experience installing similar projects and products in accordance with ASTM F 567 and have at least 5 years' experience.
- C. Tolerances: Current published edition of ASTM specifications tolerances apply. ASTM specification tolerances supersede any conflicting tolerance.

### **1.7 WARRANTY**

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Wheatland Tube Co.,
- B. Master Halco, Inc.,
- C. Southwestern Wire, Inc.,
- D. Or approved equal

### **2.2 GENERAL**

- A. Dimensions indicated herein for roll-formed pipe and H-sections are outside dimensions, excluding coatings.
- B. Fence fabric height shall be 6 feet unless otherwise indicated.
- C. Fencing materials shall be galvanized after fabrication.

- D. Fencing shall be topped with 3 lines of barbed wire on single, 45 degree supporting arms, sloped outward.

## 2.3 STEEL FABRIC

- A. Fence fabric shall be 9 gauge steel wire, 2-inch mesh, with top selvages knuckled and bottom selvages twisted and barbed.
- B. Fabric shall be hot-dip galvanized per ASTM A 392, Class 2, 2.0 oz/ft<sup>2</sup> before weaving.

## 2.4 FRAMING AND ACCESSORIES

- A. **Round steel pipe and rail:** Schedule 40 standard weight pipe, in accordance with ASTM F1083, 2.0 oz/ ft<sup>2</sup> hot dip galvanized zinc exterior and 2.0 oz/ft<sup>2</sup> hot dip galvanized zinc interior coating. Intermediate Strength Grade: Minimum yield strength 50,000 psi.
  - 1. Line post shall be 2-3/8" outside diameter, 2.0 oz/ft<sup>2</sup> zinc coating.
  - 2. End, Corner, Pull post 2-7/8" outside diameter, 2.0 oz/ft<sup>2</sup> zinc coating.
  - 3. Top, brace, bottom and intermediate rails, 1.660" outside diameter, 2.0 oz/ft<sup>2</sup> zinc coating.
- B. **Tension Wire:** Tension wire shall be located at the bottom of the fabric and shall consist of 7 gauge marcelled wire complying with ASTM A 824 and shall match the coating of the chain link fabric. Tension wire shall be interlaced with the fabric or attached to the fabric with wire ties at a spacing of no more than 18 inches apart.
- C. **Barbed Wire Support Arms:** Support arms shall be manufacturer's standard fabrication with finish to match fence framework. Support arms shall be single 45 degree arm type and shall be capable of withstanding 250 pounds of downward pull.
- D. **Barbed Wire:** Metallic coated steel barbed wire shall comply with ASTM A 121, Design Number 12-4-5-14R, double 12-1/2 gauge twisted strand wire, with 4 point 14 gauge round barbs spaced 5 inches on center. Match coating of the chain link fabric.
- E. **Tension and Brace Bands:** Galvanized pressed steel complying with ASTM F626, minimum steel thickness of 12 gauge (0.105 in.), minimum width of 3/4 inch and minimum zinc coating of 1.20 oz/ft<sup>2</sup>. Secure bands with 5/16 inch galvanized steel carriage bolts.
- F. **Terminal Post Caps, Line Post Loop Tops, Rail and Brace Ends, Boulevard Clamps, Rail Sleeves:** In compliance to ASTM F626, pressed steel galvanized after fabrication having a minimum zinc coating of 1.20 oz/ft<sup>2</sup>.
- G. **Truss Rod Assembly:** In compliance with ASTM F626, 3/8 inch diameter steel truss rod with a pressed steel tightener, minimum zinc coating of 1.2 oz/ft<sup>2</sup>, assembly capable of withstanding a tension of 2,000 lbs.
- H. **Tension Bars:** Tension bars shall be in accordance with ASTM F626 and shall be galvanized steel one-piece length 2 inch less than the fabric height. Minimum zinc coating 1.2 oz. /ft<sup>2</sup>. Bars for 2 inch mesh shall have a minimum cross section of 3/16 inch by 3/4 inch.

- I. **Tie Wire and Hog Rings:** Galvanized minimum zinc coating 1.20 oz/ft<sup>2</sup>, 9-gauge (0.148") steel wire in compliance with ASTM F626.

## 2.5 SWING GATES

- A. **Swing Gates:** Galvanized steel pipe welded fabrication in compliance with ASTM F900. Gate frame members 1.9-inch outside diameter, ASTM F 1083 schedule 40 galvanized steel pipe. Frame members spaced no greater than 8 feet apart vertically and horizontally. Welded joints protected by applying zinc-rich paint in accordance with ASTM Practice A 780. Positive locking gate latch, pressed steel galvanized after fabrication. Galvanized malleable iron or heavy gauge pressed steel post and frame hinges. Provide lockable drop bar and gate holdbacks with double gates. Match gate fabric to that of the fence system. Gateposts per ASTM F1083 schedule 40 galvanized steel pipe. The gatepost diameter from table 2.5.B.
- B. Gateposts: Schedule 40 pipe in compliance with ASTM F1083.

Gate fabric height up to and including 6 ft.		
Gate leaf width	Post Outside Diameter	Weight
up to 4 ft.	2.375 in.	3.65 lb/ft
over 4 ft. to 10 ft.	2.875 in.	5.79 lb/ft
over 10 ft. to 18 ft.	4.000 in.	9.11 lb/ft
Gate fabric height over 6 ft. to 12 ft.		
Gate leaf width		
up to 6 ft.	2.875 in.	5.79 lb/ft
over 6 ft. to 12 ft.	4.000 in.	9.11 lb/ft
over 12 ft. to 18 ft.	6.625 in.	18.97 lb/ft
over 18 ft. to 24 ft.	8.625 in.	28.58 lb/ft

## 2.6 CONCRETE

- A. Concrete for post footings shall have a 28-day compressive strength of 2,500 psi in accordance with Section 03 30 00 – Cast-in-Place Concrete.

## PART 3 EXECUTION

### 3.1 FRAMEWORK INSTALLATION

- A. Posts: Posts shall be set plumb in concrete footings in accordance with ASTM F567. Minimum footing depth, 24 inch plus an additional 3-inch depth for each 1 foot increase in the fence height over 4 feet or as indicated on the Contract Drawings whichever is greater. The minimum footing diameter shall be four times the largest cross section of the post up to a 4.00" dimension and three times the largest cross section of post greater than a 4.00-inch dimension or as indicated on the Contract Drawings, whichever is greater. Top of concrete footing to be at grade and crowned to shed water away from the post. Line posts installed at intervals not exceeding 10 feet on center.
- B. Top rail: When specified, install 21-foot lengths of rail continuous thru the line post or barb arm loop top. Splice rail using top rail sleeves minimum 6 inches long. Rail shall be secured to the terminal post by a brace band and rail end. Bottom rail or intermediate rail shall be field cut and secured to the line posts using boulevard clamps or brace band with rail end. Fences 12 feet high or higher require mid rail.

- C. Terminal posts: End, corner, pull and gate posts shall be braced and trussed for fence 6 feet and higher and for fences 5 feet in height not having a top rail. The horizontal brace rail and diagonal truss rod shall be installed in accordance with ASTM F567.
- D. Tension wire: Shall be installed 4 inches up from the bottom of the fabric. Fences without top rail shall have a tension wire installed 4 inches down from the top of the fabric. Tension wire to be stretched taut, independently and prior to the fabric, between the terminal posts and secured to the terminal post using a brace band. Secure the tension wire to each line post with a tie wire. Install the top tension wire through the barb arm loop for fences having barbed wire and no top rail.

### **3.2 CHAIN LINK FABRIC INSTALLATION**

- A. Chain Link Fabric: Install fabric to outside of the framework. Attach fabric to the terminal post by threading the tension bar through the fabric; secure the tension bar to the terminal post with tension bands and 5/16-inch carriage bolts spaced no greater than 12 inches on center. Chain link fabric shall be stretched taut free of sag. Fabric to be secured to the line post with tie wires spaced no greater than 12 inches on center and to horizontal rail spaced no greater than 18 inches on center. Secure fabric to the tension wire with hog rings spaced no greater than 18 inches on center.
  - 1. Tie wire shall be wrapped 360 degrees around the post or rail and the two ends twisted together three full turns. Excess wire shall be cut off and bent over to prevent injury. The installed fabric shall have a ground clearance on no more than 2 inches.

### **3.3 BARBED WIRE INSTALLATION**

- A. Barbed Wire: Stretched taut between terminal posts and secured in the slots provided on the line post barb arms. Attach each strand of barbed wire to the terminal post using a brace band.

### **3.4 GATE INSTALLATION**

- A. Swing Gates: Installation of swing gates and gateposts in compliance with ASTM F 567. Direction of swing shall be inward. Gates shall be plumb in the closed position having a bottom clearance of 3 inch, grade permitting. Hinge and latch offset opening space shall be no greater than 3 inches in the closed position. Double gate drop bar receivers shall be set in a concrete footing minimum 6 inch diameter 24 inch deep. Gate leaf holdbacks shall be installed for all double gates.

### **3.5 CLEAN UP**

- A. Clean Up: The area of the fence line shall be left neat and free of any debris caused by the installation of the fence.

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**SECTION 32 31 19**  
**ORNAMENTAL METAL FENCES AND GATES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This section covers the furnishing of labor, materials and appurtenances necessary for installation of the ornamental metal fence system defined herein. The manufacturer shall provide a total fence system including all components, panels, posts, gates, and hardware required.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 03 30 00 Cast-in-Place Concrete
  3. Section 31 23 23 Excavation and Backfill for Structures

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
- |                 |   |
|-----------------|---|
| 1. ASTM A 653   | Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process. |
| 2. ASTM B 117   | Standard Practice for Operating Salt-Spray (Fog) Apparatus.   |
| 3. ASTM D 523   | Standard Test Method for Specular Gloss.  |
| 4. ASTM D 714   | Test Method for Evaluating Degree of Blistering in Paint.   |
| 5. ASTM D 822   | Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.                                     |
| 6. ASTM D 1654  | Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.                           |
| 7. ASTM D 2244  | Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.       |
| 8. ASTM D 2794  | Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)                              |
| 9. ASTM D 3359  | Standard Test Methods for Measuring Adhesion by Tape Test.  |
| 10. ASTM F 2408 | Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets.  |

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit Manufacturer's product data and installation instructions for approval.

## **1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Upon receipt at the job site, all materials shall be checked to ensure that no damage occurred during shipping or handling. Materials shall be stored in such a manner to ensure proper ventilation and drainage, and to protect against damage, weather, vandalism and theft.

## **1.6 QUALITY ASSURANCE**

- A. The contractor shall provide laborers and supervisors who are thoroughly familiar with the type of construction involved and materials and techniques specified.

## **1.7 WARRANTY**

- A. All structural fence components (i.e. rails, pickets, and posts) shall be warranted within specified limitations, by the manufacturer for a period of 20 years from date of original purchase. Warranty shall cover any defects in material finish, including cracking, peeling, chipping, blistering or corroding.
- B. Reimbursement for labor necessary to restore or replace components that have been found to be defective under the terms of manufacturer's warranty shall be guaranteed for five (5) years from date of original purchase.

## **PART 2 PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Ameristar Montage II,
- B. Or approved equal

### **2.2 MATERIALS**

- A. Steel material for fence panels and posts shall conform to the requirements of ASTM A653, with a minimum yield strength of 45,000 psi and a minimum zinc (hot-dip galvanized) coating weight of 0.90 oz/sq. ft., Coating Designation G-90.
- B. Material for pickets shall be 1" square x 14 Ga. tubing. The rails shall be steel channel, 1.75" x 1.75" x 0.105". Picket holes in the rail shall be spaced 4.715" o.c. Fence posts and gate posts shall meet the minimum size requirements of Table 32 31 19-1.



Table 32 31 19-1 Minimum Sizes for Posts			
Fence Posts	Panel Height		
2-1/2" x 12 Ga.	Up to & Including 6' Height		
3" x 12 Ga.	Over 6' Up to & Including 8' Height		
Gate Leaf	Gate Height		
	Up to & Including 4'	Over 4' Up to & Including 6'	Over 6' Up to & Including 8'
Up to 4'	2-1/2" x 12 Ga.	3" x 12 Ga.	3" x 12 Ga.
4' 1" to 6'	3" x 12 Ga.	4" x 11 Ga.	4" x 11 Ga.
6' 1" to 8'	3" x 12 Ga.	4" x 11 Ga.	6" x 3/16"
8' 1" to 10'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
10' 1" to 12'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
12' 1" to 14'	4" x 11 Ga.	6" x 3/16"	6" x 3/16"
14' 1" to 16'	6" x 3/16"	6" x 3/16"	6" x 3/16"

## 2.3 FABRICATION

- A. Pickets, rails, and posts shall be pre-cut to specified lengths. Rails shall be pre-punched to accept pickets.
- B. Pickets shall be inserted into the pre-punched holes in the rails and shall be aligned to standard spacing using a specially calibrated alignment fixture. The aligned pickets and rails shall be joined at each picket-to-rail intersection by welding, thus completing the rigid panel assembly.
- C. The manufactured panels and posts shall be subjected to an inline electrodeposition coating (E-Coat) process consisting of a multi-stage pretreatment/wash (with zinc phosphate), followed by a duplex application of an epoxy primer and an acrylic topcoat. The minimum cumulative coating thickness of epoxy and acrylic shall be 2 mils (0.058 mm). The color shall be Black. The coated panels and posts shall be capable of meeting the performance requirements for each quality characteristic shown in Table 2 (Note: The requirements in Table 32 31 19-2 meet or exceed the coating performance criteria of ASTM F2408).

Table 32 31 19-2 Coating Performance Requirements		
Quality Characteristics	ASTM Test Method	Performance Requirements
Adhesion	D3359 – Method B	Adhesion (Retention of Coating) over 90% of test area (Tape and knife test).
Corrosion Resistance	B117, D714 & D1654	Corrosion Resistance over 1,500 hours (Scribed per D1654; failure mode is accumulation of 1/8" coating loss from scribe or medium #8 blisters).
Impact Resistance	D2794	Impact Resistance over 60 inch lb. (Forward impact using 0.625" ball).
Weathering Resistance	D822 D2244, D523 (60° Method)	Weathering Resistance over 1,000 hours (Failure mode is 60% loss of gloss or color variance of more than 3 delta-E color units).

- D. The manufactured fence system shall be capable of meeting the vertical load, horizontal load, and infill performance requirements for Industrial weight fences under ASTM F2408.

- E. Swing gates shall be fabricated using 1.75" x 14ga Forerunner double channel rail, 2" sq. x 11ga. gate ends, and 1" sq. x 14ga. pickets. Gates that exceed 6 feet in width will have a 1.75" sq. x 14ga. intermediate upright. All rail and upright intersections shall be joined by welding. All picket and rail intersections shall also be joined by welding. Gusset plates will be welded at each upright to rail intersection. Cable kits will be provided for additional trussing for all gates leaves over 6'.

## PART 3 EXECUTION

### 3.1 PREPARATION

- A. All new installations shall be laid out by CONTRACTOR in accordance with the Contract Documents.

### 3.2 FENCE INSTALLATION

- A. Fence post shall be spaced according to Table 32 31 19-3, plus or minus 1/2 inch. For installations that must be raked to follow sloping grades, the post spacing dimension must be measured along the grade. Fence panels shall be attached to posts with brackets supplied by the manufacturer. Posts shall be set in concrete footers having a minimum depth of 36 inches. Section 03 30 00 Cast-in-Place Concrete shall govern material requirements for the concrete footer. Posts set by other methods such as plated posts or grouted core-drilled footers are permissible only if shown by engineering analysis to be sufficient in strength for the intended application. Foundation soils shall be excavated as required for footing base/leveling pad dimensions shown on the construction drawings, or as directed by ENGINEER.

Table 32 31 19-3 Post Spacing By Bracket Type										
Span	For 8' Nominal (91-1/2" Rail)				For 8' Nominal (92-5/8" Rail)					
Post Size	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"	2-1/2"	3"
Bracket Type	Industrial Flat Mount*		Industrial Line 2-1/2" or 3"		Industrial Universal 2.5" or 3"		Industrial Flat Mount		Industrial Swivel*	
Post Settings ± 1/2" O.C.	94-1/2"	95"	94-1/2"	95"	96"	96-1/2"	96"	96-1/2"	*96"	*96-1/2"
*Note: When using swivel brackets on either or both ends of a panel installation, care must be taken to ensure the spacing between post and adjoining pickets meets applicable codes. This will require trimming one or both ends of the panel. When using the flat mount bracket for 91-1/2" rail, rail may need to be drilled to accommodate rail to bracket attachment.										

### 3.3 FENCE INSTALLATION MAINTENANCE

- A. When cutting/drilling rails or posts adhere to the following steps to seal the exposed steel surfaces.
1. Remove all metal shavings from the cut area.
  2. Apply zinc-rich primer to thoroughly cover cut edge and/or drilled hole; let dry.
  3. Apply 2 coats of custom finish paint matching fence color.
- B. Failure to seal exposed surfaces per steps 1-3 above will negate warranty. Spray cans or paint pens provided by the manufacturer shall be used to prime and finish exposed

surfaces; it is recommended that paint pens be used to prevent overspray. Use of non-manufacturer parts or components may negate the manufacturers' warranty.

### **3.4 GATE INSTALLATION**

- A. Gate posts shall be spaced according to the manufacturers' gate drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected. Type and quantity of gate hinges shall be based on the application, weight, height, and number of gate cycles. The manufacturers' gate drawings shall identify the necessary gate hardware required for the application. Gate hardware shall be provided by the manufacturer of the gate and shall be installed per manufacturer's recommendations.

### **3.5 CLEANING**

- A. CONTRACTOR shall clean the jobsite of excess materials; post-hole excavations shall be scattered uniformly away from posts.

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**SECTION 33 05 03**  
**COPPER PIPE**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. CONTRACTOR shall furnish and install all copper pipes, fittings, couplings, supports, joint materials and appurtenances as shown and specified, and as required for a complete and workable piping system.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 22 10 10 Plumbing Piping and Specialties
  - 3. Section 33 12 00 Mechanical Appurtenances
  - 4. Section 33 13 00 Pipeline Testing and Disinfection

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM B88 Standard Specification for Seamless Copper Water Tube
- C. AMERICAN WATER WORKS ASSOCIATION (AWWA)
  - 1. AWWA C 800 Standard for Underground Service Line Valves and Fittings
- D. INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)
- E. INTERNATIONAL PLUMBING CODE (IPC)
- F. INTERNATIONAL MECHANICAL CODE (IMC)

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog information on all fittings and valves shown on the Contract Drawings, referencing each item by number as shown on the Contract Drawings. Information shall indicate manufacturer specification compliance and dimensional data.

## 1.5 QUALITY ASSURANCE

- A. Reject any pipe which does not conform to Contract Documents or is cracked, chipped, crushed, dented, kinked, or otherwise unacceptable.

## PART 2 PRODUCTS

### 2.1 PIPE

- A. The type and class of the pipe and fittings shall be as indicated on the Contract Drawings and shall be Type K copper for buried services lines and Type L copper for interior piping.
- B. Type K and Type L copper pipe shall have smooth surfaces free from bumps. Type K shall also be flexible enough to be coiled. All piping shall have the capacity to function at design working pressures.
- C. Copper pipe to be buried or encased in concrete shall be polyethylene coated or installed in a polyethylene sleeve. Polyethylene coated pipe shall have a coating thickness of 0.025 inches and shall be **Mueller Industries Streamline Plastic Coated Pipe**, or approved equal. Polyethylene sleeve shall be a minimum 6 mil thick and shall be **Northtown Polywrap C**, or approved equal. The color shall be blue for cold water, red for hot water, or purple for reclaimed water. Seal seam joints and around fittings with **Polyken #930**, or approved equal, adhesive tape.

### 2.2 CONNECTIONS AND FITTINGS

- A. Connections shall be flared or compression type for service lines. All other connections for above ground and in interior to structures shall be hot 95-5 lead free soldered joints.
- B. Connections for dissimilar piping shall include dielectric insulation unions.
- C. Fittings shall conform to AWWA C 800 standards and shall be capable of operating at 150 psi.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Pipe shall be installed according to the manufacturers' instructions and per the requirements of the INTERNATIONAL PLUMBING CODE (IPC) and INTERNATIONAL MECHANICAL CODE (IMC). In case of a conflict between the two installation requirements the more stringent requirement shall apply.
- B. The pipe shall be plugged at the end of each workday or period of suspension.

### 3.2 PRELIMINARY CLEANING AND FLUSHING

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that any foreign materials do not remain in any of the piping.

### **3.3 TESTING OF PIPING**

- A. Source of Water: CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for pressure testing of the pipeline.
- B. Testing Procedure:
  - 1. Pipe shall be tested in accordance with the INTERNATIONAL PLUMBING CODE, Section 312 - Tests and Inspections.
  - 2. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall repeat the pipeline testing until the pipeline passes the leakage test, all at no additional cost to OWNER.
  - 3. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

### **3.4 DISINFECTION**

- A. For all potable water systems and where otherwise required all pipelines shall be disinfected in accordance with Section 33 13 00 – Pipeline Testing and Disinfection and approved before being allowed to be connected into a culinary system. Sewer pipelines do not require disinfection.
- B. Source of Water: CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection of the water line system.

-                      END                      OF                      SECTION                      -

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**SECTION 33 05 05**  
**DUCTILE IRON PIPE**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall furnish and install all pipe, fittings, closure pieces, supports, bolts, nuts, gaskets, jointing material, polyethylene wrap, marker tape, tracer wire, and appurtenances as shown and specified, and as required for a complete and workable piping system.
- B. Hydrostatic testing shall meet the requirements of Section 33 13 00 – Pipeline Testing and Disinfection.
- C. If there is a discrepancy between this Section or applicable AWWA Standards, the more stringent requirement shall apply.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 01 50 30 Protection of Existing Utilities
  - 3. Section 09 90 00 Painting and Finishes
  - 4. Section 31 23 15 Excavation and Backfill for Pipelines
  - 5. Section 33 12 00 Mechanical Appurtenances
  - 6. Section 33 13 00 Pipeline Testing and Disinfection

**1.3 REFERENCES**

- A. The Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
  - 1. ASTM D 2041 Cast-Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
- C. AMERICAN STANDARDS FOR TESTING AND MATERIAL (ASTM)
  - 1. ASTM A 193 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications
  - 2. ASTM A 194 Standard Specification for Carbon Steel, Alloy Steel, and Stainless-Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
  - 3. ASTM A 283 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
  - 4. ASTM A 536 Standard Specification for Ductile Iron Castings

D. American Society of Mechanical Engineers (ASME)

1. ASME B1.1 Unified Inch Screw Threads, (UN And UNR Thread Form)
2. ASME B18.2.1 Square, Hex, Heavy Hex, And Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, And Lag Screws (Inch Series)
3. ASME B18.2.2 Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, And Coupling Nuts (Inch Series)

E. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 104 Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C 105 Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C 110 Standards for Ductile-Iron and Gray-Iron Fittings, 3-inch Through 48-inch, for Water
4. AWWA C 111 Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
5. AWWA C 115 Standard for Flanged Ductile-Iron Pipe with Ductile Iron or Gray-Iron Threaded Flanges
6. AWWA C 150 Standard for the Thickness Design of Ductile-Iron Pipe
7. AWWA C 151 Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water
8. AWWA C 153 Standard for Ductile-Iron Compact Fittings, 3-inch Through 64-inch for Water
9. AWWA C 219 Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
10. AWWA C 600 Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances
11. AWWA C 606 Standard for Grooved and Shouldered Joints
12. AWWA C 651 Standard for Disinfecting Water Mains

F. NSF INTERNATIONAL (NSF)

1. NSF 61 Drinking Water System Components – Health Components

**1.4 SUBMITTALS**

- A. Submit catalog information on all pipe, fittings, valves, couplings, gaskets, tapes, bolts and nuts, wraps, safety tapes, and tracer wires as shown on the Contract Drawings. Information shall indicate manufacture specification compliance and dimensional data.
- B. Submit shop drawings on all fabricated piping and pipe supports.
- C. Submit bolting patterns, procedures, and bolting equipment data, and calculations for target torque calculations.
- D. Certified affidavit of compliance for pipe and fittings or other materials furnished under this Section and as specified in the referenced standards.
- E. Submit certification from NSF International, Truesdail Laboratories, UL Solutions, WQA, or other approved laboratory showing NSF 61 approval and limitations, if any.

## 1.5 QUALITY ASSURANCE

- A. Except as modified herein, materials used in the manufacture of the pipe shall be tested in accordance with the requirements of the referenced standards as applicable.

## PART 2 PRODUCTS

### 2.1 DUCTILE IRON PIPE

- A. Ductile iron pipe shall conform to the requirements of the AWWA C151 and AWWA C150 and pipe must be certified for potable water use by the National Sanitation Foundation (NSF/ANSI 61) and must bear the logo "NSF-pw" or "NSF-61" indicating such certification. Pipe thickness rating shall be minimum Class 53 for pipe larger than 12" diameter, and Class 350 for pipe 12" diameter and smaller, unless otherwise noted on the Contract Drawings. The pipe shall be provided with rubber gaskets, specials, and fittings as required. Nominal pipe laying lengths shall be 20-feet.
- B. Buried Ductile Iron Pipe shall be encased with 8 mil (minimum), Group 2, Class C Black polyethylene, conforming to the requirements of AWWA C105. All seams in the polyethylene encasement shall be taped with a minimum 12 mil adhesive tape, **Polyken #900, 3M Scotchrap 51**, or approved equal, to completely seal the seam.

### 2.2 FITTINGS

- A. MJ and Push-on fittings shall conform to the (AWWA C110 or C153), be NSF certified to ANSI/NSF 61 and shall be for a minimum rated working pressure of 150 psi.
- B. Flanges shall conform to AWWA C110 AWWA C111, and ANSI B16.1, Class 125/150 and shall have either raised or plain faces and shall have a minimum working pressure rating of 250 psi. For pipe sizes 24-inch and smaller, flanged joints may be rated for a maximum of 350 psi with the use of specially designed gaskets.

### 2.3 DUCTILE IRON PIPE JOINTS

- A. Ductile iron pipe and fittings shall be furnished with mechanical joints, push-on joints, flanged joints, or restrained joints as required.
  - 1. Mechanical and push-on joints shall conform to the requirements of AWWA C111.
  - 2. Flanged joints shall conform to the requirements of AWWA C115.
  - 3. Restrained joints shall conform to the requirements of AWWA C151. Restrained joints shall be **Flex-Ring, Field Flex-Ring, or Lok-Ring by American Ductile Iron Pipe, Field Lok, TR-Flex by U.S. Pipe**, or approved equal.
  - 4. Joint restraining devices that impart point loads on the pipe wall or that require a tapped anchor as a means of joint restraint shall not be allowed unless there are no other options available. CONTRACTOR may propose such devices by providing a formal substitution request indicating the locations the devices are to be used and that the devices are rated at least for the class of pipe being supplied. The joint restraint devices shall be **MegaLug Model 1100 by EBAA Iron**, or approved equal.

## 2.4 MECHANICAL-TYPE COUPLINGS (GROOVED)

- A. Mechanical-type couplings shall be provided where indicated on the Drawings and shall conform to the requirements of AWWA C606. Mechanical type couplings shall be designed for a water working pressure not less than the design pressure of the pipe on which they are to be installed. Mechanical-type couplings shall be **Victaulic Style 31 (flexible or rigid)**, or approved equal.
- B. Gaskets shall be the flush seal type.
- C. Mechanical-type couplings for equipment connections shall be provided with rigid grooved couplings or flexible type coupling with harness, unless thrust restraint is provided by other means.
- D. Grooved fittings, couplings and valves shall be furnished by the same manufacturer as the coupling. Grooving tools shall be from the same manufacturer as the grooved components.

## 2.5 SOLID SLEEVE-TYPE COUPLINGS

- A. Solid sleeve-type couplings shall be provided where shown on the Contract Drawings. Coupling shall be of ductile iron and shall be of the size to fit the pipe and fittings shown. Coupling shall be pressure rated 250 psi and comply with AWWA C110. Restraints shall be provided where indicated on the Contract Drawings.

## 2.6 DISMANTLING JOINT

- A. Provide dismantling joints were shown on the Contract Drawings. CONTRACTOR will not be allowed to substitute any other type of dismantling joint unless approved by ENGINEER. The coupling shall be rated as indicated on the Contract Drawings or to match the pressure rating of the adjoining pipe.
- B. Dismantling joint bodies shall be fabricated from steel, ASTM A512 or A 513 or Ductile Iron ASTM A536, without pipe stop. The body shall not be less than 1/4-inch thick or at least the same wall thickness as the pipe to which the joint is connected. If the strength of the body material is less than the strength of the pipe material, the thickness of the middle ring shall be increased to have the same strength as the pipe. The follower ring shall be fabricated from steel, ASTM A576 or A36.
- C. For dismantling joints installed in piping systems rated for positive pressure, the joint shall be restrained with harness bolts or tie rods. Other means of restraining the joint such as set screws will not be accepted. Harnesses shall be designed in accordance with AWWA Manual 11, or as indicated. Harness sets shall be designed for the maximum test pressure of the pipe in which they are installed.
- D. Gaskets shall be composed of a rubber-compound material that will not deteriorate from age or exposure to air under normal storage or use conditions.
- E. Dismantling joints shall be **Model 975 by Smith-Blair, Model 309 by JCM, Model DJ400 by Romac**, or approved equal.

## 2.7 MJxMJ ADAPTER

- A. Provide a positive, bolt-through restraint mechanism to connect mechanical joint valves and fittings without the use of pipe. The MJ x MJ Adapter will incorporate a bolt-through restraint mechanism design that allows for connection of MJ x MJ bells of valves and fittings with T-head bolts and pigtail bolts. The MJ x MJ Adapter and spacers shall be manufactured from high strength ductile iron in accordance with ASTM A536, Grade 65-45-12. Supplied with standard NSF-61 Approved asphaltic seal coat that conforms to ANSI/AWWA C104/A21.4 or NSF-61 approved FBE coating that conforms to ANSI/AWWA C116/A21.6. Provide gaskets, bolts, and nuts as specified herein.
- B. The MJ x MJ Adapter shall have a maximum water working pressure of 350 PSI for sizes 3-inch to 24-inch, and 250 PSI for sizes 30-inch to 36-inch and shall be used with standard Mechanical Joint fittings and valves. The MJ x MJ Adapter shall be **Star Pipe Products Series 100, Foster Adapter by Infact Corporation**, or approved equal.

## 2.8 GASKETS

- A. Except as otherwise provided, gaskets for flanged joints shall be full face, 1/8-inch thick SBR elastomer and shall have at least three (3) bulb type rings molded into both faces of the gasket. Class 250 or less flange gaskets shall be **Flange-Tyte by U.S. Pipe** or approved equal. Higher pressure joint gaskets shall be **Garlock BLUE-GARD Style 3000**, or approved equal. Wherever blind flanges are shown, the gaskets shall consist of 1/8-inch thick cloth-inserted rubber sheet which shall cover the entire inside surface of the blind flange and shall be cemented to the surface of the blind flange.
- B. All buried fittings using steel bolts shall be coated with no-oxide wax and wrapped with polyethylene or as otherwise approved by ENGINEER.

## 2.9 BOLTS AND NUTS

- A. Bolts and nuts shall be rated for the system working pressure with a minimum safety factor of three. Bolts and nuts buried, submerged, and inside vaults shall be Type 304 stainless steel. Bolts and nuts above grade, exposed or inside structures, shall be Type 304 stainless steel. Bolts and nuts in exposed to wastewater or in corrosive environments shall be Type 304 stainless steel.
- B. All flange bolt lengths shall be selected by CONTRACTOR such that three full threads, as a minimum, protrude from the hex nut and washer after assembly.
- C. Flange bolts shall have ASME B1.1, Class 2A threads, and be manufactured of ASTM A 193, Grade B7 steel. Bolts shall conform to ASME B18.2.1.
- D. Flange nuts shall have Class 2A fit, and be manufactured of ASTM A 194, Grade 2H steel, having square or hex heavy dimensions in accordance with ASME B18.2.2.
- E. Connection T-bolts for mechanical joint (MJ) fittings shall be Cor-Ten high strength, low alloy steel conforming to AWWA C111. T-Bolts and nuts shall have a zinc plating base coat and PTFE finish coat and shall be **R-Blue by Romac**, or approved equal, or a baked-on ceramic filled fluorocarbon resin and shall be **Blue Fluoropolymer by Trumbull Mfg, NAPAC Kor-10Blu, Sigma**, or approved equal.

## 2.10 CEMENT MORTAR LINING

- A. Ductile iron pipe and fittings shall be lined with cement mortar in accordance with the requirements of the AWWA C104 except that the lining thickness shall be not less than 1/8 of an inch. The pipe interior surfaces shall be smooth and free from fractures, excessive crazing, and roughness.

## 2.11 THRUST BLOCKS/ RESTRAINTS

- A. All fittings for pipe 20-inch diameter and larger shall not have thrust blocks, but joint restraints for the adjacent pipe shall be provided for the distances indicated on the Contract Drawings. All fittings for pipes smaller than 20-inch diameter shall have proper thrust blocks and restraints as noted for the type of installation required. Joint restraint shall be provided for all bends, fittings, and valves regardless of pipe size or location. Thrust blocks shall be concrete as per OWNER's Standards.
- B. Joint restraints may be tie rods, **TR Flex piping system as manufactured by US Pipe**, or approved equal, or a **Megalug system as manufactured by EBAA Iron**. Where the required pipeline deflection exceeds the recommended deflection of the TR Flex piping system, CONTRACTOR shall use Megalugs to achieve specified deflections.
- C. Restrained joints shall be suitable for 250 psi test pressures.

## 2.12 SAFETY TAPE

- A. Safety tape shall be a minimum of 3-inch wide by 5.0 mil overall thickness, with no less than a 0.35-gauge solid aluminum foil core. It shall be Safety Blue in color per American Public Works Association (APWA) National Color Code and shall be clearly labeled with the words "CAUTION WATER LINE BELOW" or similar wording approved by ENGINEER. Safety tape shall be **MagnaTec by Empire Level Mfg Corp**, or approved equal.

## 2.13 TRACER WIRE

- A. All piping (including service lines) shall be installed with 12-gauge solid copper THHN tracer wire for pipeline location purposes by means of an electronic line tracer.
  - 1. The wires must be installed along the entire length of the pipe on the top of the pipe and be held in place with poly tape at all pipe joints and at 5 foot intervals.
  - 2. Sections of wire shall be spliced together using approved splice caps and waterproof seals. Twisting the wires together is not acceptable.

## 2.14 PIPE COATINGS

- A. All exposed piping, valves, and fittings including inside vaults and buildings and exposed to the atmosphere shall be painted as specified in Section 09 90 00 – Painting and Finishes. Exposed piping, valves, and fittings to be painted shall be primed by the manufacturer in preparation for painting. CONTRACTOR shall provide verification from the finish coating supplier that the field applied coatings are compatible with the manufacturer's prime coat. Pipe to be painted shall not have asphalt emulsion coating. The exterior of buried pipe and fittings shall be an asphaltic coating approximately one-mil thick.

## 2.15 COLD-APPLIED WAX TAPE COATING

- A. Apply wax tape coating over all flanges, valves, actuators, joints, nuts, bolts, and all metallic appurtenances which are buried.
- B. Primer: Primer shall be a blend of petrolatums, plasticizers, and corrosion inhibitors having a paste-like consistency. The primer shall have the following properties:
- |                 |   |
|-----------------|---|
| 1. Color        | Brown   |
| 2. Pour Point   | 100°F to 110°F  |
| 3. Flash Point  | 350°F   |
| 4. Coverage     | 1 gallon/100 square feet  |
| 5. Manufacturer | <b>Trenton Wax Tape Primer, Denso Paste Primer</b> , or approved equal. |
- C. Wax Tape: Wax tape shall consist of a synthetic fiber felt, saturated with a blend of microcrystalline wax, petrolatums, plasticizers, and corrosion inhibitors, forming a tape coating that is easily formable over irregular surfaces. The tape shall have the following properties:
- |                        |   |
|------------------------|---|
| 1. Color               | Brown   |
| 2. Saturant Pour Point | 115°F to 120°F  |
| 3. Thickness           | 50 to 70 mils   |
| 4. Tape Width          | 6 inches  |
| 5. Dielectric Strength | 100 volts/mil   |
| 6. Manufacturer        | <b>Trenton No. 1 Wax Tape, Denso "Densyl Tape"</b> , or approved equal. |
- D. Plastic Wrapper: Wrapper shall be a polyvinylidene chloride plastic with three 50-gauge plies wound together as a single sheet. The wrapper shall have the following properties:
- |                 |  |
|-----------------|--|
| 1. Color        | Clear  |
| 2. Thickness    | 1.5 mils   |
| 3. Tape Width   | 6 inches   |
| 4. Manufacturer | <b>Trenton Poly-Ply, Denso Tape PVC Self-Adhesive</b> , or approved equal. |

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Ductile iron fittings shall be installed in accordance with the ANSI/AWWA C 600. Inspect each pipe and fitting prior to installation to verify there is no damage and clean each pipe and fitting prior to installation.
- C. Pipe shall be laid directly on the bedding material. Bell holes shall be formed at the ends of the pipe to prevent point loading.

- D. No pipe shall be installed on a foundation into which frost has penetrated or at any time that there is a danger of the formation of ice or penetration of frost at the bottom of the excavation before backfilling occurs.
- E. Immediately before joining the pipe, the bell end of the pipe shall be thoroughly cleaned. The spigot end of the pipe and the inside surface of the gasket shall be cleaned and lubricated. The lubricant shall be non-toxic, shall not support bacteria growth, shall not be harmful to the gasket material, and shall be compliant with NSF/ANSI 61 requirements. The lubricant shall not impart a taste or odor to the water in the pipe. Tilting of the pipe to insert the spigot into the bell will not be permitted.
- F. Buried Ductile Iron pipe shall be polyethylene encased in accordance with the requirements of AWWA C105 Method A. Remove all lumps of clay, mud, cinders, etc. on the pipe surface before installation of the encasement. During installation, soil or embedment material shall not be trapped between the pipe and the polyethylene. Cut polyethylene tube to a length at least 2 feet longer than the pipe section. Wrap shall overlap the adjacent pipe joint at least 1 foot. After assembling the pipe joint, overlap the joint with the polyethylene tube and secure to the pipe with adhesive tape completely around the seam. Overlap the joint on the previous pipe with the polyethylene tube and secure to the existing wrap with adhesive tape and completely seal the seam. Take up the slack width at the top of the pipe to make a snug but not tight fit along the barrel of the pipe and secure with poly tape at 5 foot intervals. For installations below the water table or wet areas, circumferential wraps of tape should be placed at 2 foot intervals along the barrel of the pipe prior to lowering the pipe into the trench.
- G. Repair punctures to the polyethylene wrap with adhesive tape. Repair cuts, tears, or damage to the polyethylene wrap with a tube cut open, wrapped around the pipe to cover the damaged area, and secure in place with **Polyken #900, 3M Scotchrap 51**, adhesive tape, or approved equal, to completely seal the seam.
- H. Provide openings for branches, service taps, blowoffs, air valves, and similar appurtenances by cutting an "X" in the polyethylene and temporarily folding back the film. After the appurtenance is installed, tape the slack securely to the appurtenance, and repair the cut and any other damaged areas.
- I. To make a direct tap, apply two or three wraps of adhesive tape completely around the polyethylene encased pipe to cover the area where the tapping machine and chain will be mounted. Install the corporation stop directly through the tape and polyethylene encasement. After the direct tap is completed, inspect for damage and repair if needed.
- J. Where polyethylene wrapped pipe joins an adjacent pipe that is not wrapped, extend the polyethylene wrap to cover the adjacent pipe for a distance of 3 feet. Secure the end with adhesive tape completely around the seam. Service lines with dissimilar metals shall be wrapped with polyethylene or approved dielectric tape for a minimum clear distance of 3 feet away from the ductile iron pipe.
- K. Valves shall be handled in a manner to prevent damage to any part of the valve. CONTRACTOR shall adjust stem packing and operate each valve prior to installation to insure proper operation. Valves shall be installed so that the valve stems are plumb and, in the location, indicated on the drawings.
- L. The pipe shall be plugged at the end of each workday or period of suspension.



- M. Safety tracer tape shall be installed 12-inches above the pipe along the entire length of pipeline.
- N. Tracer wire shall be brought up at valve boxes and fire hydrants as shown on the Drawings. Tracer wire does not need to be brought up at shut-off valves for fire hydrants. When splicing a wire use a greased filled or approved connector. All splices should occur within a valve box. Wire is to be continuous underground. Underground splices may only be used by specific permission of the OWNER and must be inspected before backfill.

### **3.2 THRUST BLOCKS**

- A. Thrust blocks shall be installed at points where the pipe changes direction such as: tees, elbows, wyes, caps, valves, hydrants, reducers, etc. according to the Contract Drawings.
- B. Thrust blocks shall be constructed so that the bearing surface is in direct line with the major force created by the pipe or fitting.
- C. Thrust blocks shall bear against solid undisturbed earth at the side and bottom of the trench excavation and shall be shaped so as not to obstruct access to the joints or the pipe or fitting.
- D. Thrust blocks shall be sized and constructed per OWNER's Standards or the Contract Drawings, whichever is greater.

### **3.3 PRELIMINARY CLEANING AND FLUSHING**

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material do not remain in any of the pipeline. If possible, the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

### **3.4 BOLTING PROCEDURES FOR FLANGED JOINTS**

- A. Flange joints shall be assembled per the gasket manufacturer's instructions and as specified herein. Utilize calibrated bolting equipment capable of applying a measured torque to flange bolts during joining. Bolting patterns, procedures, and bolting equipment data shall be submitted prior to pipe fitting and bolting.
- B. Gaskets, bolts, and anti-seize lubricant used in the bolting procedure shall be selected from those specified herein. Submit target torque calculations for each application. Calculations shall identify specific gasket (manufacturer, model, size, configuration, material), bolts (size and material), and anti-seize lubricant. The calculations shall document and take into consideration the pipe service, working and test pressures, pipe diameter, gasket data sheet, bolt material, gasket supplier-recommended assembly stress, and gasket-supplier recommended bolt stress. Calculations shall be stamped by a professional engineer. Target torque calculations shall be used in the assembly of bolted joints.
- C. Flange bolts, nuts, and washers shall be visually inspected and cleaned prior to bolting. Lubricate bolts and nuts; if hardened washers are not used, lubricate the flange surface

around the bolt holes. This lubricant must be removed by cleaning solvent prior to applying a coating system. Hand-tighten all nuts and bolts then tighten them to 10 to 20 percent of the target torque. The initial torque shall not exceed 20 percent of the target torque. The bolts shall be tightened according to the pattern included in AWWA Manual M11, Figure 12-3.

- D. For flanges having 4 to 8 bolts there shall be three rounds of tightening, after hand tightening, to 30 percent, 60 percent and then 100 percent of the target torque. For flanges having 12 or more bolts there shall be four rounds of tightening, after hand tightening, to 20 percent, 40 percent, 80 percent and 100 percent of the target torque. At 100 percent of target torque the flange gap shall be measured at every other bolt to confirm uniformity. The bolts shall be re-tightened to the target torque 24 hours after completion of the initial bolting sequence.

### **3.5 COLD-APPLIED WAX TAPE COATING APPLICATION**

- A. Surfaces shall be clean and free of all dirt, grease, water, and other foreign material prior to the application of the primer and wax tape.
- B. Apply primer by hand or brush to all surfaces of the pipefitting or valve. Work the primer into all crevices and completely cover all exposed metal surfaces.
- C. Apply the wax tape immediately after the primer application. Work the tape into the crevices around fittings. Wrap the wax tape spirally around the pipe and across the fitting. Use a minimum overlap of 55 percent of the tape width.
- D. Work the tape into the crevices and contours of irregularly shaped surfaces and smooth out so that there is a continuous protective layer with no voids or spaces under the tape. For larger voids or irregular shaped surfaces fill spaces with a moldable mastic. Moldable mastic shall be **Trenton Fill-Pro PM-GP**, or approved equal.
- E. Overwrap the completed wax tape installation with the plastic wrapping material. Wrap spirally around the pipe and across the fitting. Use a minimum overlap of 55 percent of the tape width and apply two layers or applications of overwrap. Secure plastic wrapper to pipe with adhesive tape.

### **3.6 TRACER WIRE TESTING**

- A. Tracer wire shall be installed where indicated above or shown on the Contract Drawings on the pipe along the entire length of pipeline.
- B. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
  - 1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER and/or ENGINEER.
  - 2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

### **3.7 HYDROSTATIC FIELD TESTING OF PIPE**

- A. CONTRACTOR shall provide additional temporary blow-off valves and fittings as required to flush and disinfect new pipelines as required in Section 33 13 00 – Pipeline Testing and Disinfection. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- B. Source of Water
  - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for pressure testing of the pipeline.
- C. Testing Procedure
  - 1. The pipe working pressure is 150 psi unless noted otherwise on the Contract Drawings.
  - 2. Pipe test pressure shall not exceed 125% of the working pressure unless taken into consideration during design. The test pressure shall not exceed the thrust-restraint design pressure or 1.5 times the pressure rating of the pipe or joint, whichever is less.
  - 3. For projects with long pipeline segments, the test pressure shall not be less than 125% of the design operating pressure at the highest elevation on the pipeline and shall not be less than 150% of the working operating pressure at the lowest elevation on the pipeline.
  - 4. Hydrostatic testing shall be in accordance with the requirements of AWWA C 600 and Section 33 13 00 - Pipeline Testing and Disinfection. In case of a conflict between these two references, the more stringent requirement shall be followed.
  - 5. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the excessive leakage, shall take corrective measures necessary to repair the leaks, and shall repeat the pipeline test, all at no additional cost to OWNER.
  - 6. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test
  - 7. Air pressure testing will not be allowed.
- D. Exposed piping and valves shall show no visible leaks and no pressure loss during the test.

### **3.8 DISINFECTING**

- A. Disinfection shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.
- B. Connection of new piping to existing piping will only be allowed after successful completion of disinfection and testing of the new piping.

### **3.9 PAINTING**

- A. All exposed piping including inside vaults and structures shall be coated as specified in Section 09 90 00 – Painting and Finishes.

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**SECTION 33 05 07.1**  
**POLYVINYL CHLORIDE (PVC) PRESSURE PIPE**  
**(ASTM D 1785)**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall furnish and install all PVC pressure pipe and appurtenances as shown and specified, and as required for a complete and workable piping system.
- B. This Section includes PVC pressure pipe with solvent-welded, flanged, or threaded joints in accordance with ASTM D 1785 as modified herein.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 05 45 00 Mechanical Metal Supports
  - 3. Section 31 23 15 Excavation and Backfill for Pipelines
  - 4. Section 33 12 00 Mechanical Appurtenances
  - 5. Section 33 13 00 Pipeline Testing and Disinfection

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
  - 1. ANSI B 16.5 Pipe Flanges and Flanged Fittings Class 150
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM D 1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
  - 2. ASTM D 2467 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
  - 3. ASTM F 1498 Standard Specification for Taper Pipe Threads 60 Degrees for Thermoplastic Pipe and Fittings
- D. AMERICAN WATER WORKS ASSOCIATION (AWWA)
  - 1. AWWA C 605 Standard for Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
  - 2. AWWA C 651 Standard for Disinfecting Water Mains
  - 3. AWWA M 23 Manual of Water Supply Practices - PVC Pipe - Design and Installation
- E. NSF INTERNATIONAL (NSF)

#### **1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.
- C. Submit shop drawings of pipe, fittings, and appurtenances showing compliance with this Section, and manufacturer's literature on tracer wire and accessories.
- D. Submit certification from NSF International, Truesdail Laboratories, UL Solutions, or other approved laboratory showing NSF 61 approval and limitations, if any.
- E. Submit plan for commissioning the waterline, including but not limited to cleaning, pressure testing, and disinfection.

### **PART 2 PRODUCTS**

#### **2.1 POLYVINYL CHLORIDE PIPE**

- A. PVC pipe shall be made from new rigid unplasticized polyvinyl chloride and shall be normal impact Type 1, Grade 1, class 12454, listed as compliant with NSF Standard 61, unless otherwise indicated, in accordance with ASTM D 1785.
- B. Pipe sections shall be clearly marked to:
  - 1. Identify manufacturer's name or trademark
  - 2. Nominal pipe size and OD base
  - 3. ASTM material code designation
  - 4. Schedule
  - 5. Pressure class
  - 6. ASTM specification designation
  - 7. Product record code
- C. The PVC pipe shall be schedule 80 for a maximum working pressure of 150 psi.

#### **2.2 PIPE JOINTS**

- A. Pipe joints shall be solvent-welded type with solvent cement and primer as recommended by the pipe manufacturer for the chemical in the pipe. Solvent for potable water pipe and fittings shall be NSF 61 certified.
- B. Threaded joints that are necessary to match up to threaded valves or fittings shall be made up with appropriate thread sealant, either paste or tape.
- C. Flanged joints shall be made with solvent-welded PVC flanges, drilled to ASME B 16.5 - Pipe Flanges and Flanged Fittings, Class 150, unless otherwise indicated. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

## **2.3 FITTINGS**

- A. Solvent-welded and threaded fittings shall be Schedule 80 PVC fittings in accordance with ASTM D 2467 - Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
- B. Flanged fittings shall be Schedule 80 fabricated PVC fittings with 150 lb. flanges to ASME B 16.5.

## **2.4 TRACER WIRE**

- A. All buried piping (including service lines) shall be installed with 12-gauge solid copper THHN tracer wire for pipeline location purposes by means of an electronic line tracer.
  - 1. The wires must be installed along the entire length of the pipe on the top of the pipe and be held in place with ties or hitches spaced not more than 12-feet apart.
  - 2. Sections of wire shall be spliced together using approved splice caps and waterproof seals or solder. Twisting the wires together is not acceptable.

# **PART 3 EXECUTION**

## **3.1 INSTALLATION**

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. PVC pipe shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- C. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00 – Mechanical Metal Supports (Pipe Supports). Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- D. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Valves and flanges attached to PVC pipe shall be provided with adequate supports.

## **3.2 PIPE PREPARATION**

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

### **3.3 PIPE JOINTS**

- A. Pipe threads shall conform to ASTM F 1498 and shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape or thread sealant.
- B. Solvent-welded joints shall be made with fresh primer and solvent cement on clean, dry pipe ends. The primer and cement cans shall be kept closed at all times and the joints shall be made up at the recommended ambient temperatures, according to the pipe or cement manufacturer's written recommendations. Pipe ends shall be inserted to the full depth of the socket. Solvents used on potable water pipes shall be ANSI/NSF 61 certified.
- C. Flanged joints shall be made with gaskets and Type 316 stainless steel bolts and nuts, unless noted otherwise. Care shall be taken not to over-torque the bolts, in accordance with the manufacturer's written recommendations.

### **3.4 PRELIMINARY CLEANING AND FLUSHING**

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipeline. If possible the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

### **3.5 TRACER WIRE TESTING**

- A. Upon completion of the pipe installation, CONTRACTOR shall demonstrate that the wire is continuous and unbroken through the entire run of the pipe.
  - 1. Demonstration shall include full signal conductivity (including splices) when energizing for the entire run in the presence of OWNER OR ENGINEER.
  - 2. If the wire is broken, CONTRACTOR shall repair or replace it. Pipeline installation will not be accepted until the wire passes a continuity test.

### **3.6 INSPECTION AND TESTING OF PIPELINE**

- A. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- B. Source of Water
  - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- C. Testing Procedure
  - 1. CONTRACTOR shall allow adequate time for the solvent cement joints to cure. Curing time shall be per the solvent cement manufacturer's recommendation. Prior to enclosure or burying, piping systems shall be pressure tested as required on the Contract Drawings, for a period of not less than one hour, without exceeding the



- tolerances listed on the Contract Drawings. Caution - Do not use air or gas for testing PVC pipe. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. CONTRACTOR shall furnish test equipment, labor, materials, and devices
2. In Leakage shall be determined by loss of pressure. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
  3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
  4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

### **3.7 DISINFECTING**

- A. Disinfection shall be in accordance with Section 33 13 00 – Pipeline Testing and Disinfection.

-                   END                   OF                   SECTION                   -

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**SECTION 33 05 07.2**  
**POLYVINYL CHLORIDE (PVC) SEWER PIPE**  
**(ASTM D 3034)**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall furnish and install all PVC sewer pipe and appurtenances as shown and specified, and as required for a complete and workable piping system.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:

1. Section 01 33 00 Submittal Procedures
2. Section 31 23 15 Excavation and Backfill for Pipelines

**1.3 REFERENCES**

- A. The Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.

- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. ASTM C 1173 Standard Specification for Flexible Transition Couplings for Underground Piping Systems
2. ASTM D 1784 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Compounds
3. ASTM D 2321 Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
4. ASTM D 2412 Standard Specification for External Loading Properties of Plastic Pipe by Parallel-Plate Loading
5. ASTM D 2444 Standard Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
6. ASTM D 3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings
7. ASTM D 3212 Standard Specification for Joints for Drain and Sewer Plastic Pipe Using Flexible Elastomeric Seals
8. ASTM F 477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
9. ASTM F 913 Standard Specification for Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe
10. ASTM F 1417 Standard Practice for Installation Acceptance of Plastic Non-Pressure Sewer Lines Using Low-Pressure Air

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.

- B. Submit Shop Drawings and laying diagrams of pipe, joints, bends, special fittings, and piping appurtenances.
- C. Submit manufacturer's certificate that the pipe conforms to these specifications.
- D. Submit plan for commissioning the sewer pipeline, including but not limited to cleaning and testing plan. The written testing plan shall include methods for water conveyance, leak testing, and water disposal.

## **PART 2 PRODUCTS**

### **2.1 POLYVINYL CHLORIDE PIPE**

- A. PVC sewer pipe shall conform to the requirements of ASTM D 3034 for pipe sizes 3-inch to 48-inch. Material for PVC pipe shall conform to the requirements of ASTM D 1784, for cell classification 12454 or 12364 as defined therein. The manufacturer shall test a sample from each batch according to ASTM D 2444.
- B. Joints shall conform to ASTM D 3212. Elastomeric seals for compression type joints shall conform to the requirements of ASTM F 477 or ASTM F 913.
- C. Pipe sections shall be clearly marked to:
  - 1. Identify manufacturer's name or trademark
  - 2. Nominal pipe size and OD base
  - 3. ASTM material code designation
  - 4. Dimension Ratio
  - 5. ASTM specification designation
  - 6. Product record code
- D. The PVC pipe shall meet the testing in accordance with ASTM D 2412 and shall be SDR 35 for a maximum bury depth of 25 feet.

### **2.2 FITTINGS**

- A. Fittings shall conform to the requirements of ASTM D 3034. The ring groove and gasket ring shall be compatible with PVC pipe ends.
- B. The stiffness of the fittings shall be no less than the stiffness of the adjoining pipe.

### **2.3 FLEXIBLE COUPLINGS**

- A. Flexible couplings shall be neoprene, full-circle, clamp-on type conforming to ASTM C1173 and provided with 2 stainless steel band screw-clamps to secure the coupling tightly to entering and exiting pipes. Screw-clamp hardware shall be Type 304 or Type 316 stainless steel. Neoprene material shall be suitable for sewage service.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.

- B. PVC pipe shall be installed in accordance with the requirements of ASTM D 2321 and as indicated. Pipe sections shall be closely jointed to form a smooth flow line. Immediately before placing each section of pipe in final position for jointings, the bedding for the pipe shall be checked for firmness and uniformity of slope.
- C. Handling of the pipe shall be done with tools as recommended by the pipe manufacturer to ensure the pipe is not damaged in any manner during storage, transit, loading, unloading and installation. Pipe shall be inspected both prior to and after installation in the ditch and all defective lengths shall be rejected and removed from the working area.
- D. Fittings shall be lowered into the trench by means of rope, cable, chain, or other means without damage. Cable, rope, or other devices used for lowering the fitting into the trench shall be attached around the exterior of the fitting for handling never through the interior of the fitting.
- E. Adequate protection and maintenance of all underground and surface utility structures, drains, sewers, and other obstructions encountered in the progress of the work shall be CONTRACTOR's responsibility.
- F. Where the grade or alignment of the pipe is obstructed by existing utility structures such as conduits, ducts, pipes, branch connections to main sewers, or main drains, the obstruction shall be permanently supported, relocated, removed, or reconstructed by the CONTRACTOR in cooperation with owners of such utility structures. Unless otherwise indicated, protection of existing utility structures shall be CONTRACTOR's responsibility.
- G. When pipe laying is not in progress, the open ends of the pipe shall be closed to prevent trench water from entering pipe. Adequate backfill shall be deposited on pipe to prevent floating of pipe. Any pipe that has floated shall be removed from the trench, cleaned, and re-laid in an acceptable manner. No pipe shall be laid when, in the opinion of ENGINEER, the trench conditions or weather are unsuitable.

### **3.2 PIPE PREPARATION**

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. The ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly.

### **3.3 PIPE JOINTS**

- A. Each pipe compression type joint shall be joined with a lock-in rubber ring and a ring groove that is designed to resist displacement during pipe insertion.
- B. The ring and the ring seat inside the bell shall be wiped clean before the gasket is inserted. A thin film of lubricant shall be applied to the exposed surface of the ring and to the outside of the clean pipe end. Lubricant other than that furnished with the pipe shall not be used. The end of the pipe shall be then forced into the ring to complete the joint.
- C. The pipe shall not be deflected either vertically or horizontally in excess of the printed recommendations of the manufacturer of the coupling.
- D. Fittings shall be carefully connected to pipe and joint shall be checked to insure a sound and proper joint.

### 3.4 PRELIMINARY CLEANING AND FLUSHING

- A. CONTRACTOR shall flush the pipeline as the work progresses by a means in accordance with good practice to ensure that sand, rocks, or other foreign material are not left in any of the pipeline. If possible, the flushing shall be made with an open pipe end.
- B. CONTRACTOR shall provide to ENGINEER a proposed schedule and method of flushing for review before the flushing starts.

### 3.5 INSPECTION AND TESTING OF PIPELINE

- A. PVC sewer pipes and service laterals shall be tested for exfiltration or infiltration and deflection as indicated. Pipes shall be backfilled prior to testing. Leakage tests shall be completed and approved prior to placing of permanent resurfacing of pavement. When leakage or infiltration exceeds the allowed amount, CONTRACTOR shall locate the leaks and make the necessary repairs or replacements to reduce the leakage or infiltration to the allowable limits. Individually detectable leaks shall be repaired, regardless of whether the test results are acceptable or not.
- B. Source of Water
  - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- C. No materials shall be used which would be injurious to pipeline structure and future function. Air test gauges shall be laboratory-calibrated test gauges and shall have a size and pressure range appropriate for the pipe being tested.
- D. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.
- E. PVC sewer pipe 30-inches and smaller shall be tested for deflection by the mandrel (deflection gauge) test. Larger flexible pipe shall be tested by a method approved by ENGINEER. The outside diameter of the mandrel shall be 95 percent of the inside diameter of the pipe. The mandrel barrel length shall be at least 75 percent of the pipe inside diameter. The mandrel shall utilize a nine-arm design and shall be **938-96 Series by Petersen**, or approved equal. Provide a proving ring or mandrel that is field verifiable without a proving ring. Excessively deflected pipe shall be removed and replaced.

### 3.6 WATER EXFILTRATION TEST

- A. Each section of sewer shall be tested between successive manholes by closing the lower end and the inlet sewers of the upper manhole with stoppers or inflatable plugs. The pipe and manhole shall be filled with water to a point at least 2-feet above the centerline of the sewer at the center of the upper manhole; or if ground water is present, 2-feet above the average adjacent ground water level, whichever is higher.
- B. During testing the maximum internal pipe pressure at the lowest end should not exceed 10.8 psi (25 feet). The average internal pressure should not exceed 5 psi (11.6 feet).

- C. Water shall remain in the pipe for at least one hour or until the water level stabilizes, whichever is longer, before the test begins. The minimum test duration shall be 4 hours.
- D. Unless indicated otherwise, CONTRACTOR shall measure exfiltration. Measure the amount of water added to the upstream manhole to maintain the water level at the elevation set above. Compare the amount added to the allowable leakage calculated below, and if the amount added is equal to or less than the allowable amount, the tested section of the pipe has passed.
- E. The allowable leakage shall not exceed 25 gallons per inch of internal pipe diameter per mile per day.

### 3.7 WATER INFILTRATION TEST

- A. The end of the sewer at the upper structure shall be closed to prevent the entrance of water, and pumping of ground water shall be discontinued for at least 3 days, after which the section shall be tested for infiltration.
- B. The infiltration into each individual reach of sewer between adjoining manholes shall not exceed 25 gallons per inch of internal pipe diameter per mile per day.
- C. Unless otherwise indicated, infiltration shall be measured by CONTRACTOR.

### 3.8 AIR PRESSURE TEST

- A. CONTRACTOR shall furnish all materials, equipment, and labor for making an air test. Air test equipment shall be approved by ENGINEER.
- B. The test of the pipe and service laterals shall be conducted in the presence of ENGINEER. Testing of the pipe shall be performed in accordance with ASTM F 1417.
- C. Air pressure in the sewer line shall be increased to 4.0 psi above groundwater pressure (1.0 psi for each 2.3 feet of water elevation above the highest point of the pipe). Do not allow the pressure at any point in the pipe to reach 9 psi under any circumstances. Allow the pressure to stabilize for 5 minutes, then reduce the pressure to 3.5 psi above groundwater pressure and start the test. Stop the air release and record the decrease in pressure over time.
- D. Pass/Fail Criterion: The time taken for the pressure to decrease from 3.5 to 2.5 psi above groundwater pressure shall be equal to or greater than the time below.

Nominal Pipe Diameter (inch)	Minimum Time (min:sec)	Length for Minimum Time (feet)	Increased Time for Longer Lengths (seconds per foot)
4	3:46	597	0.380
6	5:40	398	0.854
8	7:34	298	1.520

10	9:26	239	2.374
12	11:20	199	3.418
15	14:10	159	5.342
18	17:00	133	7.692
21	19:50	114	10.470
24	22:40	99	13.674
27	25:30	88	17.306
30	28:20	80	21.366
33	31:10	72	25.852
36	34:00	66	30.768
42	39:48	57	41.883
48	45:34	50	54.705

- E. For pipes larger than 24-inches, air pressure tests may be performed on each joint. The time for the pressure to fall from 3.5 to 2.5 psi, both above groundwater pressure, shall not be less than 10 seconds regardless of pipe diameter.
- F. If the time is less than the allowable time, the pipe will be considered defective and shall be repaired and retested.

### 3.9 DEFLECTION TEST

#### A. Mandrel Test

1. CONTRACTOR shall test all flexible pipe 30-inches and smaller for deflection, joint displacement, and other obstructions by passing the mandrel through the pipe not less than 30 days after completion of the trench backfill, but prior to permanent pavement resurfacing.
2. Pipe with diameter less than the mandrel will be considered defective, and CONTRACTOR shall replace it.

- B. Flexible pipe in sizes larger than 30-inches shall have deflections measured by a rigid metal bar, a rigid frame, or other method approved by ENGINEER.

### 3.10 VIDEO INSPECTION

- A. Inspect PVC gravity pipe and document the inspection by video camera of the entire pipe. Provide the video inspection in electronic format to OWNER.



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**SECTION 33 05 13**  
**PRECAST CONCRETE MANHOLES AND STRUCTURES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. CONTRACTOR shall provide precast concrete manholes and structures (vaults), complete and in place, in accordance with the Contract Documents.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:

- |                       |  |
|-----------------------|--|
| 1. Section 01 33 00   | Submittal Procedures                             |
| 2. Section 01 45 00   | Quality Control and Materials Testing            |
| 3. Section 01 60 00   | Product Requirements                             |
| 4. Section 31 23 15   | Excavation and Backfill for Buried Pipelines     |
| 5. Section 31 23 23   | Excavation and Backfill for Structures           |
| 6. Section 33 05 05   | Ductile Iron Pipe                                |
| 7. Section 33 05 07.2 | Polyvinyl Chloride (PVC) Sewer Pipe (ASTM D3034) |

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

- |                |  |
|----------------|--|
| 1. ASTM A 48   | Standard Specification for Gray Iron Castings  |
| 2. ASTM A 536  | Standard Specification for Ductile Iron Castings   |
| 3. ASTM A 615  | Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement   |
| 4. ASTM A 1018 | Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Hot-Rolled, Carbon, Commercial, Drawing, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength |
| 5. ASTM B 86   | Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings  |
| 6. ASTM C 150  | Standard Specification for Portland Cement   |
| 7. ASTM C 478  | Standard Specification for Precast Reinforced Concrete Manhole Sections  |
| 8. ASTM C 497  | Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile   |
| 9. ASTM C 857  | Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures  |
| 10. ASTM C 858 | Standard Specification for Underground Precast Concrete Utility Structures   |
| 11. ASTM C 913 | Standard Specification for Precast Concrete Water and Wastewater Structures  |

- 12. ASTM C 923      Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.
- 13. ASTM C 990      Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
- 14. ASTM C 1802     Standard Specification For Design, Testing, Manufacture, Selection, And Installation Of Horizontal Fabricated Metal Access Hatches For Utility, Water, And Wastewater Structures

C. AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

- 1. AASHTO M 306    Standard Specification for Drainage, Sewer, Utility, and Related Castings

#### **1.4 SUBMITTALS**

- A. CONTRACTOR shall provide Submittals in accordance with Section 01 33 00 - Submittal Procedures.
- B. Shop Drawings: Indicate manhole and concrete structure locations, elevations, and piping sizes, material, and elevations of penetrations.
- C. Product Data: Submit cover and frame construction, features, configuration, and dimensions. Submit pipe connector materials and dimensions. Submit manhole step materials and dimensions. Submit manhole and structure joint sealant materials.

#### **1.5 QUALITY ASSURANCE**

- A. CONTRACTOR shall demonstrate that manholes and structures have been properly installed, level, with tight joints, at correct elevations and orientations, and have been backfilled and compacted in accordance with the specifications.

#### **1.6 DELIVERY, STORAGE AND HANDLING**

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Comply with precast concrete manufacturer's instructions for unloading, storing, and moving precast manholes and structures.
- C. Store precast concrete manholes and structures to prevent damage to OWNER's property or other public or private property. Repair property damaged from materials storage.
- D. Mark each precast structure by indentation or waterproof paint showing date of manufacture, manufacturer, and identifying symbols and numbers shown on Contract Drawings to indicate its intended use.

## PART 2 PRODUCTS

### 2.1 MANHOLES

- A. Reinforced precast concrete manholes in accordance with ASTM C 478 with HS-20 loading. Axial length of barrel sections shall be selected to provide the correct total height with the fewest joints. Conical sections shall be designed to support cast iron frames and covers under H-20 loading, unless noted otherwise. Design criteria shall be as shown in the Contract Drawings. Manholes shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal.
- B. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102, Ram-Nek RN101**, or approved equal, conformation to ASTM C 990. Wrap exterior section joints with membrane waterproofing and exterior joint wrap meeting the requirements of ASTM C877, Type III, **Marmac, Conseal CS212, or Press-Seal Corp EA-Wrap**, or approved equal.
- C. Barrel section to pipe connections shall be sealed with resilient connectors, **Kor-N-Seal by Trelleborg**, or approved equal, complying with ASTM C 923. Mechanical devices shall be stainless steel.

### 2.2 STRUCTURES

- A. Provide reinforced concrete structures and vaults designed for the applications and sizes as shown on the Contract Drawings. Structures shall conform to the requirements of ASTM C 857, ASTM C 858, or ASTM C 913 as required. The minimum wall thickness shall be 5-inches. Cement shall be Type V Portland cement conforming to the requirements of ASTM C 150. The minimum 28-day concrete compressive strength shall be 4,000 psi. Reinforcing steel shall be embedded in the concrete with a minimum rebar clear cover as recommended by ACI 318. Structures and vaults shall be manufactured by **Oldcastle Precast, Geneva Pipe and Precast**, or approved equal.
- B. Structures in areas subject to traffic shall be designed for H-20 traffic loading. Structures in other areas shall be designed for a vertical live load of 300 psf.
- C. Where joints are required, joints shall be interlocking to secure proper alignment between members and shall prevent migration of soil through the joint. Joints shall be sealed with butyl-rubber sealants, **ConSeal CS-102, Ram-Nek RN101**, or approved equal, conforming to ASTM C 990. Wrap exterior section joints with membrane waterproofing and exterior joint wrap meeting the requirements of ASTM C877, Type III, **Marmac, Conseal CS212, or Press-Seal Corp EA-Wrap**, or approved equal.
- D. Openings, where required, shall be of the size and location indicated on the Contract Drawings and shall be provided without obstructions from brackets and supports. Unless noted otherwise, frames and covers shall be fabricated from steel and galvanized after fabrication. Frames shall be integrally cast into the structure concrete sections. Covers shall be tight fitting to prevent dirt and debris entering the structure.
- E. Where penetrations are required for piping, conduits, or ducts, such penetrations shall be through precast openings or core drilled through unreinforced thin-wall knock-out sections. Penetrations shall be smooth and exposed reinforcing steel will not be allowed. Unless

noted otherwise, structures do not need to be designed to resist thrust from piping passing through the structure.

## **2.3 FRAMES AND COVERS**

- A. Manufacturers or approved equal shall be:
  - 1. D & L Foundry and Supply, East Jordan, Neenah Foundry Co. Model Number shall be as shown on the Contract Drawings.
- B. Product Description: Casting frames and covers shall be non-rocking and shall conform to the requirements of ASTM A 48, Class 35B for Gray Iron and ASTM A 536 for ductile iron. Unless noted otherwise, cast iron covers and frames shall be 30-inches in diameter, machined flat bearing surface, removable lid; HS-20 load rating; with embossed lettering saying WATER cast into cover.

## **2.4 COMPONENTS**

- A. Manhole and Structure Steps shall have a 1/2-inch ASTM A 615 grade 60 steel reinforcement rod encased in polypropylene copolymer plastic. Steps shall have a tread width of 14-inches nominal. Steps shall be manufactured by **American Step Company, Inc., M.A. Industries**, or approved equal.

## **2.5 CONFIGURATION**

- A. Shaft Construction: Square or rectangular with flat lid top section; lipped male/female joints; shaped to receive pipe sections.
- B. Clear Inside Dimensions: As indicated on the Contract Drawings.
- C. Design Depth: As indicated on the Contract Drawings.
- D. Clear Cover Opening: As indicated on the Contract Drawings.

## **2.6 BEDDING AND COVER MATERIALS**

- A. Bedding: 3/4-inch Washed Rock as specified in Section 31 23 23 – Excavation and Backfill for Structures.
- B. Soil Backfill to Finish Grade: Trench Backfill Material as specified in Section 31 23 15 – Excavation and Backfill for Buried Pipelines.

# **PART 3 EXECUTION**

## **3.1 EXAMINATION**

- A. Verify items provided by other sections of Work are properly sized and located.
- B. Verify built-in items are in proper location, and ready for roughing into Work.
- C. Verify correct size of manhole and structure excavation.

### **3.2 PREPARATION**

- A. Do not install structures where site conditions induce loads exceeding structural capacity of structures.
- B. Inspect precast concrete structures immediately prior to placement in excavation to verify structures are internally clean and free from damage. Remove and replace damaged units.

### **3.3 PRECAST CONCRETE MANHOLE AND STRUCTURE INSTALLATION**

- A. Lift precast components at lifting points designated by manufacturer.
- B. When lowering manholes and structures into excavations and joining pipe to units, take precautions to ensure interior of pipeline and structure remains clean.
- C. Set precast structures bearing firmly and fully on crushed stone bedding, compacted in accordance with provisions of Section 31 23 23 – Excavation and Backfill for Structures.
- D. Assemble multi-section structures by lowering each section into excavation. Lower, set level, and firmly position base section before placing additional sections.
- E. Remove foreign materials from joint surfaces and verify sealing materials are placed properly. Maintain alignment between sections by using guide devices affixed to lower section.
- F. Joint sealing materials may be installed on site or at the manufacturer's plant.
- G. Verify manholes and structures installed satisfy required alignment and grade.
- H. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe.
- I. Steps shall be installed 12-inches on centers vertically not more than 1/2-inch out of plumb. The top step shall not be more than 12-inches below the manhole cover.
- J. Prior to backfilling, fill all cracks and voids in the manholes or vaults with non-shrink grout or polyurethane sealant.

### **3.4 FRAME AND COVER INSTALLATION**

- A. Set frame and cover 2-inches above finished grade for manholes and structures with covers located within unpaved areas to allow area to be graded away from cover beginning 1-inch below top surface of frame.
- B. In paved areas set frame and cover 1/4-inch below finished grade and install concrete collar.

### **3.5 FIELD QUALITY CONTROL**

- A. Section 01 45 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

B. Vertical Adjustment of Existing Manholes and Structures

1. Where required, adjust top elevation of manholes and structures to finished grades shown on Contract Drawings.
2. Reset existing frames, grates and covers, carefully removed, cleaned of mortar fragments, to required elevation in accordance with requirements specified for installation of castings.

- END OF SECTION -



**SECTION 33 05 26**  
**UTILITY IDENTIFICATION**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall provide and install identification markers for all exposed valves, piping, equipment, tanks, and warning signs, all in accordance with these specifications and the Contract Documents.

**1.2 RELATED WORK**

- A. Related work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 09 90 00 Painting and Finishes

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
  - 1. ANSI A13.1 Scheme for the Identification of Piping Systems
  - 2. ANSI Z535 Safety Signs and Colors
- C. AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)
  - 1. ASTM D 1593 Standard Specification for Nonrigid Vinyl Chloride Plastic Film and Sheeting
  - 2. ASTM D 3652 Standard Test Method for Thickness of Pressure-Sensitive Tapes

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's data sheets showing wording, symbols, letter size, and color coding.
- C. Submit one sample of each type of identification device to be used.
- D. Submit sample of each proposed color required by the color schedule.
- E. Submit the manufacturer's installation instructions.

**1.5 QUALITY ASSURANCE**

- A. Product manufacturer shall be ISO 9001 Quality Certified.

## PART 2 PRODUCTS

### 2.1 VALVE TAGS

- A. General: Provide each valve of size 2-inch and larger with an identification tag. Tag shall show the pipeline station (if applicable), type, manufacturer, date of manufacture, and pressure rating.
- B. Metal Tags:
  - 1. Brass: 19 gauge thick solid brass, with 3/16-inch (5 mm) top hole for fastener, natural brass finish. Manufacturer shall be **Seton, Brady**, or approved equal.
  - 2. Aluminum: 19 gauge thick aluminum, anodized. Teflon coated both sides, with Code 39 bar codes. Manufacturer shall be **Seton, Brady**, or approved equal.
  - 3. Stainless Steel: 0.6 mm (0.025 inch) thick, Grade 304 stainless steel. Manufacturer shall be **Seton, Brady**, or approved equal.
  - 4. Lettering: Pre-Stamped, Stamped, or Engraved letters; character size and words according to ANSI A13.1.
- C. Beaded Chains: No. 6 stainless steel, 114 mm (4-1/2 inch) long, with locking link.
- D. OR Nylon Ties: Colored, 200 mm (8 inches) long, nonconductive, locking type.
- E. Chart: Typewritten letter size list in anodized aluminum frame.

### 2.2 PIPE MARKERS

- A. General: Labels for piping shall bear the full piping system name. Provide flow arrows and working pressure next to each label.
- B. Self-Adhesive Pipe Markers:
  - 1. Vinyl: Factory fabricated vinyl, 0.102 mm (5 mil) thick, preformed to fit around pipe or pipe covering. Model **Opti-Code by Seton, B-946 by Brady**, or approved equal.
  - 2. Polyester: Factory fabricated polyester, 0.05 mm (2 mil) thick, coated with acrylic adhesive. Model **Poly-Code by Seton**, or approved equal.
  - 3. Plastic: Factory fabricated plastic film, roll formed, clear laminated to protect lettering.
- C. Identify fluid being conveyed and include flow direction arrow.
  - 1. Language: English.
  - 2. Lettering: Size and Color according to ANSI A 13.1.
- D. Color and Text per the Schedule at the end of this Section.

### 2.3 HOSE BIB SIGNS NON-POTABLE WATER

- A. Provide a properly labeled, rigid sign for each hose bib. Signs shall contain the header, pictogram/alert symbol, and messaging conforming to OSHA/ANSI A 535 requirements. Minimum size shall be 7-inch high by 10-inch wide. Signs shall be plastic with overlamine and be pre-drilled for mounting. Manufacturer shall be **Seton, Brady**, or approved equal.

## 2.4 LABELS FOR EQUIPMENT AND TANKS

- A. Provide a label for each piece of mechanical equipment and/or tank. The label shall contain the equipment name, tag number, and identifying information such as size, liquid, horsepower, etc. Minimum label size shall be 1-1/2 inches by 4-inches. Labels shall be stainless steel, brass, or aluminum. Fiberglass labels may be used for corrosive environments. Manufacturer shall be **Brady, Seton**, or approved equal.

## 2.5 LABELS FOR AUTOMATIC START/STOP EQUIPMENT

- A. Provide a sign reading "CAUTION – EQUIPMENT STARTS AND STOPS AUTOMATICALLY" on equipment as shown on the drawings on identified in the specifications. Signs shall be vinyl with self-adhesive for application to the equipment. Minimum size shall be 7-inches by 10-inches. Manufacturer shall be **Brady, Seton**, or approved equal.

## 2.6 WARNING SIGNS

- A. Provide a properly labeled, rigid warning sign as shown on the drawings. Signs shall contain the header, pictogram/alert symbol, and messaging conforming to OSHA/ANSI A 535 requirements. Minimum size shall be 7-inch high by 10-inch wide. Signs shall be plastic with overlamine and be pre-drilled for mounting. Manufacturer shall be **Seton, Brady**, or approved equal.

# PART 3 EXECUTION

## 3.1 GENERAL

- A. Markers and identification tags shall be installed in accordance with the manufacturer's printed instructions and shall be neat and uniform in appearance. Tags and markers shall be readily visible from all normal working locations.

## 3.2 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

## 3.3 INSTALLATION

- A. Valve Tags:
  - 1. Install tags with corrosion resistant chains.
  - 2. Identify valves in main and branch piping with tags.
  - 3. Identify small devices, such as in-line pumps, with tags.
  - 4. Tag automatic controls, instruments, and relays.
- B. Pipe Markers:
  - 1. Identify all above grade piping. Include service, flow direction, and working pressure.
  - 2. Provide snap-on type markers for pipes 6-inch diameter and smaller. Provide strap-on type for pipes over 6-inch diameter.
  - 3. Each pipe shall be marked at:
    - a. Intervals of 20-feet in straight runs.
    - b. At least once in every room.

- c. Within 2 –feet of bends and valves.
- d. On the upstream side of Tees, branches, and other distribution points.
- e. On both sides of walls and floors through which the piping passes.

C. Automatic Start/Stop Equipment

- 1. Attach signs for exposed equipment directly to the equipment.
- 2. Attach signs for sump pumps on the adjacent wall.

D. Warning Signs

- 1. Attach to walls according to the manufacturer's recommendations.

E. Equipment and Tank Labels

- 1. Attach labels to equipment with a pop rivet or equal.

### 3.4 SCHEDULES

Color Schedule				
Pipe Contents		Pipe Color	Marker Color	Letter Color
Abbreviation	Identification			
NG	Natural Gas	Org-Red/Black	Yellow	Black
PPS	Pump Suction (Potable Water)	Light Blue	Green	White
PW	Potable Water	Dark Blue	Green	White
RWL	Rain Water Leader		Green	White
SA	Sample Line		Yellow	Black
SD	Sanitary Drains	Dark Gray	Yellow	Black
SDR	Storm Drain	Green	Green	White
UW	Utility Water (Non-Potable Water)	Magenta	Yellow	Black
V	Vent	Dark Brown	Yellow	Black

- END OF SECTION -

**SECTION 33 08 30**  
**GRAVITY PIPELINE TESTING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall test sanitary system, overflow, storm drain, and other gravity drains in accordance with these specifications and with the Contract Documents.
- B. CONTRACTOR shall be responsible for obtaining permits for discharging excess testing water and dechlorination of such water, if required.

**1.2 RELATED SECTIONS**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 33 05 05 Ductile Iron Pipe
  - 3. Section 33 05 07.2 Polyvinyl Chloride (PVC) Sewer Pipe

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of this Specification to the extent referenced. The publications are referred to in the text by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM C 828 Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines
  - 2. ASTM C 969 Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
  - 3. ASTM C 1103 Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
  - 4. ASTM D 3034 Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
  - 5. ASTM F 1417 Standard Test Method for Installation of Plastic Gravity Sewer Line Using Low Pressure Air

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Furnish a written testing plan and schedule, including water source and methods for conveyance to the project, sequence, control, and disposal.
- C. Where deflection testing of flexible pipe is required, submit a method for mandrel testing or other measurement, as applicable to pipe size.

## **1.5 PERFORMANCE REQUIREMENTS**

- A. Gravity flow sanitary sewers are required to have a straight alignment and uniform grade between manholes.
- B. Flexible pipe, including “semi-rigid” pipe, is required to show no more than 5 percent deflection. Test pipe no sooner than 30 days after backfilling of a line segment but prior to final acceptance using a standard mandrel to verify that installed pipe is within specified deflection tolerances.
- C. Maximum allowable leakage for infiltration and exfiltration:
  - 1. The total infiltration or exfiltration shall not exceed 50 gallons per inch diameter per mile of pipe per 24 hours at a minimum test head of 2 feet above the crown of the pipe at the upstream manhole or 2 feet above the groundwater elevation, whichever is greater.
- D. Time allowed for pressure loss from 3.5 psig to 2.5 psig shall be per Table 33 08 30 – 2 at the end of this Section.

## **PART 2 MATERIALS**

### **2.1 DEFLECTION MANDREL**

- A. Design: CONTRACTOR shall construct a mandrel of steel or rigid plastic which can withstand a force of 200 psi without deforming. The mandrel shall have 9 or more “runners” or legs, as long as the number is an odd number. The mandrel barrel length shall be at least 75 percent of the pipe inside diameter.
- B. Sizing: The rigid mandrel shall have an outside diameter (OD) equal to 95 percent of the inside diameter (ID) of the pipe. The inside diameter of the pipe, for the purpose of determining the outside diameter of the mandrel, shall be the average outside diameter minus two minimum wall thicknesses for OD controlled pipe and the average inside diameter for ID controlled pipe. Dimensions shall be per appropriate standard. Statistical or other “tolerance package” shall not be considered in mandrel sizing.

### **2.2 VIDEO EQUIPMENT**

- A. Use color video equipment. Prepare three copies of the video in electronic format and deliver to OWNER and one copy to ENGINEER. Record the project name, contractors name, date recorded, and locations of the video.
- B. Produce a video using a pan-and-tilt radial-viewing pipe inspection camera that pans 275 degrees and rotates 360 degrees. Use a camera with an accurate footage counter which displays on the monitor the exact distance of the camera from the centerline of the starting manhole. Use a camera with camera height adjustment so that the camera lens is always centered at one-half the inside diameter, or higher, in the pipe being videoed. Provide a lighting system that allows the features and condition of the pipe to be clearly seen. A reflector in front of the camera may be required to enhance lighting in dark or large diameter pipes.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Gravity pipes shall be tested for exfiltration or infiltration and deflection as indicated. Manholes and pipe shall be backfilled prior to testing. The maximum length of pipe tested shall be the 4 reaches between 5 manholes. Leakage tests shall be completed and approved prior to placing of permanent resurfacing of pavement. When leakage or infiltration exceeds the allowed amount, CONTRACTOR shall locate the leaks and make the necessary repairs or replacements to reduce the leakage or infiltration to the allowable limits. Individually detectable leaks shall be repaired, regardless of whether the test results are acceptable or not.
- B. CONTRACTOR shall assume all responsibility to obtain the necessary water for testing of the gravity pipes.
- C. No materials shall be used which could damage the pipeline.
- D. Air test gauges shall be laboratory-calibrated test gauges, and if required by ENGINEER, shall be recalibrated by a certified laboratory prior to the leakage test. Air test gauges shall have a size and pressure range appropriate for the pipe being tested.
- E. Testing shall be performed in the presence of OWNER and/or ENGINEER.
- F. Remove debris, sediment, and other material from installed pipe prior to testing. Do not discharge or flush sand, gravel, concrete, debris, or other foreign material into any existing pipeline system. Flushing with clean water only will be allowed but with minimal flows to eliminate exceeding capacities of the existing gravity systems.

### **3.2 TESTING SCHEDULE**

#### **A. Leakage Tests**

1. Perform leakage tests as determined from the Table 33 08 30 - 1 below:

TABLE 33 08 30 - 1				
	Criterion 1 Slope Between Manholes		Criterion 2 Difference in Water Levels	
Pipe Size	Manhole Delta H (feet)		Test Water vs Ground Water Delta H (feet)	
	Less than or equal to 10 ft	Greater than 10 ft	Greater than or equal to 4 ft	Less than 4 ft
Less than or equal to 24 inches	See Criterion 2	Infiltration or Air (See Note 1)	Exfiltration	Infiltration or Air
Greater than 24 inches	See Criterion 2	See Criterion 2	Exfiltration	Infiltration
Notes: 1) If groundwater is present and at least 1 foot above the top of the pipe, perform an infiltration test. If groundwater is not present, perform an air test. 2) Definitions: a) Manhole Delta H is the invert elevation difference between two adjacent manholes. b) Test Water vs Groundwater Delta H is the required elevation of water surface for testing minus the average elevation of groundwater adjacent to the pipe to be tested.				

### 3.3 AIR PRESSURE TEST

- A. Air testing for sections of pipe shall be limited to lines less than 36-inch average inside diameter.
- B. Lines 36-inch average inside diameter and larger shall be "joint" tested at each joint. The minimum allowable for the pressure drop from 3.5 psig to 2.5 psig during a joint test shall be 10 seconds, regardless of pipe size. Joint test shall be conducted as follows:
  1. Each joint shall be tested successfully.
  2. Joint tester shall be set over joint to be tested so that the two inflation tubes straddle the joint.
  3. Inflate tubes to 25 psig to seal off joint to be tested.
  4. Apply air pressure into void between inflation tubes until pressure reaches 4 psig.
  5. After pressure has stabilized, bleed air pressure back to 3.5 psig.
  6. Record time required for pressure to drop from 3.5 psig to 2.5 psig.
  7. If the time in seconds for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than 10 seconds, the joint shall be presumed to be free from defect. When the time is less than 10 seconds pipe breakage, joint leakage, or leaking testing seals are indicated and an inspection must be made to determine the cause. CONTRACTOR shall affect such repairs as may be required to accomplish a successful air joint test.
- C. For pipe sections less than 36-inch average inside diameter:
  1. Determine the groundwater level.



2. Plug both ends of the pipe. For concrete pipe, flood pipe and allow 2 hours to saturate concrete. Then drain and plug pipe.
  3. After a manhole-to-manhole section of pipe has been sliplined and prior to any services lines being connected to new liner, plug liner at each manhole with pneumatic plugs.
  4. Pressurize pipe to 4.0 psig. Increase pressure 1.0 psi for each 2.3 feet of ground water over highest point in the system. Allow pressure to stabilize for 2 to 4 minutes. Adjust pressure to start at 3.5 psig (plus adjustment for ground water table). See Table 33 08 30 - 2 at the end of this Section.
  5. To determine air loss, measure the time interval for pressure to drop to 2.5 psig. The time must exceed that listed in the Table 33 08 30 - 2 at the end of this Section for pipe diameter and length. For sliplining, use diameter of carrier pipe.
- D. The test of the pipe and service laterals shall be conducted in the presence of ENGINEER. Testing of pipe, regardless of the pipe material, shall be performed in accordance with ASTM C 828, C 1103, or ASTM F 1417, as applicable.
- E. Any section of pipe which fails to meet requirements shall be repaired and retested.

### 3.4 EXFILTRATION TEST

- A. Exfiltration testing shall be completed in accordance with ASTM C 969 and as modified below. Testing shall be conducted in the presence of ENGINEER and/or OWNER.
- B. Each section of gravity lines shall be tested between successive manholes by closing the lower end and the inlet gravity lines of the upper manhole with stoppers or inflatable plugs. The pipe and manhole shall be filled with water to a point 4-feet above the centerline of the gravity line at the center of the upper manhole; or if ground water is present, 4-feet above the average adjacent ground water level, whichever is higher.
- C. Water shall remain in the pipe for at least one hour or until the water level stabilizes, whichever is longer, before the test begins. The minimum test duration shall be 4 hours.
- D. Unless indicated otherwise, CONTRACTOR shall measure exfiltration. Measure the amount of water added to the upstream manhole to maintain the water level at the elevation set above. Compare the amount added to the allowable leakage calculated below, and if the amount added is equal to or less than the allowable amount, the tested section of the pipe has passed.
- E. The allowable leakage will be computed by the formula:

$$E = 0.000012 LD (H)^{1/2}$$

Where:

- E = Allowable leakage in gallons per minute of gravity line tested.
- L = Length of gravity line and house connections tested, in feet.
- D = Internal diameter of the pipe, in inches.
- H = Elevation difference in feet between the water surface in the upper manhole and the centerline of the pipe at the lower manhole; or if ground water is present above the centerline of the pipe in the lower manhole,

the difference in elevation between the water surface in the upper manhole and the ground water at the lower manhole.

### **3.5 INFILTRATION TEST**

- A. Infiltration testing shall be completed in accordance with ASTM C 969 and as modified below. Testing shall be conducted in the presence of ENGINEER and/or OWNER.
- B. Groundwater elevation must be not less than 2 feet above the highest point of pipe or service lead (house service).
  - 1. Determine groundwater elevation
  - 2. Plug incoming pipes in upstream manhole.
  - 3. Insert calibrated 90° V-notch weir in pipe on downstream manhole.
  - 4. Allow water to rise and flow over weir until it stabilizes.
  - 5. Take five readings of accumulated volume over a period of 2 hours and use average for infiltration. The average must not exceed that calculated using the equation in paragraph 3.4.D above.

### **3.6 DELFECTION TEST**

- A. Mandrel Test
  - 1. CONTRACTOR shall test all flexible and semi-rigid pipe 30-inches and smaller for deflection, joint displacement, and other obstructions by passing the mandrel through the pipe not less than 30 days after completion of the trench backfill, but prior to permanent pavement resurfacing.
  - 2. Testing shall confirm the pipe has no more than 5 percent deflection. Mandrel testing shall conform to ASTM D 3034. Pull the approved mandrel by hand through sewer sections.
  - 3. Pipe with diameter less than the mandrel will be considered defective and CONTRACTOR shall replace it.
- B. Flexible or semi-rigid pipe larger than 30-inches shall have deflections measured by a rigid metal bar, a rigid frame, or other method approved by ENGINEER.
  - 1. The average inside diameter shall be measured before the pipe is installed and backfilled.
  - 2. Deflection is defined as the difference between vertical inside diameter in the pipe before and after installation and backfilling.

### **3.7 MANHOLE TEST**

- A. Manholes shall be hydrostatically tested for leakage prior to backfilling. Prior to testing, manholes shall be visually inspected for obvious defects. Leaks or cracks shall be repaired to the satisfaction of ENGINEER.
- B. All pipes entering the manhole shall be sealed at a point outside the manhole walls to include testing of the pipe to manhole joints. The manhole shall be filled with water to a level 2-inches below the top of the frame. Safety lines shall be secured to all plugs utilized. After a period of at least one hour to allow the water level to stabilize, the

manhole shall be refilled, and the water level shall be marked. The water level shall again be checked after 4 hours. The maximum leakage shall be 0.025 gallons per foot of manhole diameter per foot of manhole depth per hour. The exterior of the manhole shall be inspected during this period for visible evidence of leakage. Visible moisture, sweating, or beads of water on the exterior of the manhole shall not be considered leakage, but any water running across the surface will be considered leakage and shall be repaired to the satisfaction of ENGINEER regardless of the volume of water lost.

### **3.8 VIDEO INSPECTION**

- A. Immediately after cleaning and testing, video the gravity pipeline to document the condition of the line. Notify ENGINEER 24 hours in advance of any video inspection so that ENGINEER or RESIDENT PROJECT REPRESENTATIVE may observe inspection operations.
- B. Survey video inspection shall be continuous for pipe segments between manholes. Do not leave gaps in the videotaping of a segment between manholes and do not show a single segment on more than one file.
- C. Do not pull or propel the video camera through the line at a speed greater than 30 feet per minute.

### **3.9 ALIGNMENT AND GRADE TEST**

- A. Line and grade of pipe may not vary more than 1/2 inch in 10 feet and not more than 1 inch variance from true line at any location.
- B. Grade of pipe may not vary more than 1/4 inch in 10 feet for all design grades less than or equal to 1 percent and not more the 1/2-inch total variance from true grade at any location. Also, the grade of pipe may not vary more than 1/2 inch in 10 feet for all design grades greater than 1 percent and not more than 1 inch total variance from true grade at any location. These tolerances shall be acceptable provided that such variation does not result in a level or reverse sloping invert.
- C. The variation in the invert elevation between adjoining ends of pipe due to eccentricity of joining surface and pipe interior surfaces shall not exceed 1/64 inch per inch of pipe diameter, or 1/4 inch maximum.

TABLE 33 08 30 – 2 (1.0 psi Pressure Drop)												
Pipe Diameter (inch)	Minimum Time (min:sec)	Length for Minimum Time (ft)	Time for Longer Length (sec/ft)	Specification Time for Length (L) Shown (min:sec)								
				100 ft	150 ft	200 ft	250 ft	300 ft	350 ft	400 ft	450 ft	500 ft
6	5:40	398	0.8548	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:25	7:07
8	7:33	298	1.5196	7:33	7:33	7:33	7:33	7:36	8:52	10:08	11:24	12:40
10	9:27	239	2.3743	9:27	9:27	9:27	9:54	11:52	13:51	15:50	17:48	19:47
12	11:20	199	3.4190	11:20	11:20	11:20	14:15	17:06	19:57	22:48	25:39	28:30
15	14:10	159	5.3423	14:10	14:10	17:48	22:16	26:43	31:10	35:37	40:04	44:31
18	17:00	133	7.6928	17:00	19:14	25:39	32:03	38:28	44:52	51:17	57:42	64:06
21	19:50	114	10.4708	19:50	26:11	34:54	43:38	52:21	61:05	69:48	78:32	87:15
24	22:40	99	13.6762	22:48	34:11	45:35	56:59	68:23	79:47	91:10	102:34	113:58
27	25:30	88	17.3089	28:51	43:16	57:42	72:07	86:33	100:58	115:24	129:49	144:14
30	28:20	80	21.3690	35:37	53:25	71:14	89:02	106:51	124:39	142:28	160:16	178:05
36	34:00	66	30.768	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46	256:24
42	39:48	57	41.883	69:48	104:42	139:37	174:30	209:24	244:19	279:13	314:07	349:02
48	45:34	50	54.705	91:10	136:45	182:21	227:55	273:31	319:06	364:42	410:17	455:53
54	51:02	44	69.236	115:24	173:05	230:47	288:29	346:11	403:53	461:34	519:16	576:58
60	56:40	40	85.476	142:28	213:41	284:55	356:09	427:23	498:37	569:50	641:04	712:18

- END OF SECTION -

**SECTION 33 12 00**  
**MECHANICAL APPURTENANCES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. CONTRACTOR shall furnish and install all valves, and equipment, complete and operable in accordance with the Specifications.
- B. Where 2 or more valves or equipment of the same type and size are required, the valves shall be furnished by the same manufacturer.
- C. CONTRACTOR shall verify that flanges on pipe match the bolt hole pattern of the flanges on the mechanical appurtenances.
- D. All appurtenances shall be NSF 61 certified if used in potable water systems.
- E. Unless noted otherwise below or in the Contract Drawings, all system components shall be rated for the maximum system pressure or higher.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 01 45 00 Quality Control & Materials Testing
  - 3. Section 01 50 00 Temporary Construction Utilities and Environmental Controls
  - 4. Section 31 23 15 Excavation and Backfill for Buried Pipelines
  - 5. Section 31 23 23 Excavation and Backfill for Structures
  - 6. Section 33 05 05 Ductile Iron Pipe and Fittings

**1.3 REFERENCES**

- A. The latest edition of the following publications form a part of these Specifications to the extent referenced. The publications are referred to in the text to by basic designation only.
- B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. A 126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
  - 2. A 216 Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
  - 3. B 584 Standard Specification for Copper Alloy Sand Castings for General Applications
- C. AMERICAN WATER WORKS ASSOCIATION (AWWA)
  - 1. AWWA C 504 Rubber-Seated Butterfly Valves, 3-inch through 72-inch
  - 2. AWWA C 509 Resilient-Seated Gate Valves for Water Supply Service

3. AWWA C 512 Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service
4. AWWA C 515 Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
5. AWWA C 518 Dual-Disc Swing-Check Valves for Waterworks Service
6. AWWA C 550 Protective Interior Coatings for Valves and Hydrants
7. AWWA C 800 Underground Service Line Valves and Fittings

D. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

1. ANSI B 16.1 Gray Iron Pipe Flanges and Flanged Fittings
2. ANSI B 16.34 Valves – Flanged, Threaded, and Welding End

E. NSF INTERNATIONAL (NSF)

1. NSF/ANSI 61 Drinking Water System Components - Health Effects

F. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)

1. MSS-SP-80 Bronze Gate, Globe, Angle, and Check Valves
2. MSS-SP-110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
3. MSS-SP-139 Copper Alloy Gate, Globe, Angle, and Check Valves for Low Pressure/Low Temperature Plumbing Applications

## 1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog cut sheets on all mechanical appurtenances including fittings, valves, or other items shown on the Contract Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance, Cv factor, pressure rating, and dimensional data.

## PART 2 PRODUCTS

### 2.1 GATE VALVES

- A. Gate valves shall conform to the requirements of AWWA C 509 . Valves shall be of the resilient-seat type with non-rising stem (NRS), opening to the left, and provided with a 2-inch square operating nut for buried valves or hand wheel for valves located in structures. Buried valves shall be of flange or mechanical joint design to match pipe joint system.
- B. Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes to 3-inches above grade in unimproved areas or at grade with concrete collar in improved areas. All valves and gates shall be new and of current manufacture.
- C. The valve shall have a two-part thermosetting or fusion bonded epoxy protective coating (10 mil minimum inside and out) system that is non-toxic and imparts no taste to water.

The epoxy shall be applied in accordance with AWWA C550 and be ANSI/NSF 61 certified.

- D. The flanges of valves may be raised or plain faced. Flanges of valves shall be faced and drilled to 125-lb American Standard template. Provide ASME Class 250 flanges for valves located on the high-pressure discharge side piping.
- E. All valves shall be furnished with pressure classes equal to or better than the pressure class of the pipe with which the valves are to be used. Unless otherwise specified, each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- F. Valves shall be manufactured by **Mueller Co., Clow Valve Co., American Flow Control, Kennedy Valve Co., American AVK Company (high pressure)**, or approved equal.

## 2.2 BUTTERFLY VALVES

- A. Butterfly valves shall conform to the following requirements:
  - 1. Butterfly valves shall have a double offset disc design to reduce torque and seat wear, known as a double eccentric type. Valves shall be AWWA C504 Standard Class 150B. Valves shall be NSF 61 certified.
  - 2. The valves shall have a heavy-duty ductile iron body conforming to ASTM A 536 65-45-12 with flanges fully faced and drilled per ANSI B16.1 Class 150B. Maximum flow velocity shall be less than 16 fps for cold water service. Working pressure rating shall be a minimum of 250 psi.
  - 3. Disc body shall conform to ASTM A536 65-45-12 or 60-40-18 and shall be pinned used 2205 Duplex stainless steel pin. Disc seat shall be elastomeric and shall be secured to the disc with Type 316 stainless steel hardware. Disc seat shall be EPDM unless manufacturer recommends alternative which demonstrates better resistance to abrasion.
  - 4. Body seat shall be 316L stainless steel and shall be applied through a high alloy weld double overlay process with a minimum thickness of 5mm.
  - 5. The valve shall have a hand wheel operator and shall be geared to close slowly. Position indicator shall be provided with valve.
  - 6. The valve shall have a fusion bonded epoxy protective coating inside and outside with a minimum DFT of no less than 14 mils. Coating shall meet AWWA C 550 and shall be non-toxic and impart no taste to water.
- B. The valve shall be manufactured by **Av-Tek, VAG, AVK**, or approved equal.
- C. Provide 1-year warrantee against manufacturer defects, with labor replacement costs.

## 2.3 FLEXIBLE EXPANSION JOINTS

- A. Flexible expansion joints shall be installed in the locations indicated on the Contract Drawings and shall be manufactured of ductile iron conforming to the material requirements of ASTM A 536 and ANSI/AWWA C 153/A21.53. Foundry certification of material shall be readily available upon request.

- B. Each flexible expansion joint shall be pressure tested prior to shipment against its own restraint to a minimum of 350 psi (250 psi for flexible expansion joints 2 inch and 30 inches diameter and larger.) A minimum 2:1 safety factor, determined from the published pressure rating, shall apply. Factory Mutual Approval for the 3 inch through 12 inch sizes is required.
- C. Each flexible expansion joint shall consist of an expansion joint designed and cast as an integral part of a ball and socket type flexible joint, having a minimum per ball deflection of: 20°, 2" - 12"; 15°, 14" - 36"; 12°, 42"-48" and 4-inches minimum expansion. Additional expansion sleeves shall be available and easily added or removed at the factory or in the field. Both standardized mechanical joint and flange end connections shall be available.
- D. All internal surfaces (wetted parts) shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213. Sealing gaskets shall be constructed of EPDM. The coating shall meet ANSI/NSF-61.
- E. Exterior surfaces shall be coated with a minimum of 6 mils of fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C116/A21.16.
- F. Appropriately sized polyethylene sleeves, meeting ANSI/AWWA C105/A21.5, shall be included for direct buried applications.
- G. The Flexible Expansion Joints shall be **Flex-Tend by EBBA Iron**, or approved equal.

## 2.4 BALL VALVES

- A. Valves shall be rated for the working pressure of the system. Valves for use in potable water systems shall be NSF 61 certified and NSF 372 lead free.
- B. **Stainless Steel Ball Valves** shall be full port opening stainless steel and have adjustable stem packing gland. Body and ball shall be stainless steel in accordance with ASTM A351. Seats shall be reinforced PTFE and packing stem shall be PTFE. The handle shall be Type 304 stainless steel with vinyl insulator. The valves shall conform to MSS-SP-110. The valves shall be manufactured by **Apollo 76F-100-A, NIBCO T-585-S6-R-66-LL, Watts Series S-FBV-1**, or approved equal.
- C. **Brass Ball Valves** shall be full port opening brass, blow out proof stem design, adjustable stem packing, secondary O-ring stem seal, zinc plated steel handle with vinyl insulator. The valves shall conform to MSS-SP-110. Provide **Apollo Series 77F-100, Watts Series LFB6801, NIBCO FP600A-LF, FNW X410C**, or approved equal.

## 2.5 SERVICE SADDLES

- A. Shall consist of a 2-piece bronze body and strap, meeting applicable sections of AWWA C800.
- B. Outlet shall be tapped with AWWA I.P. thread (F.I.P.T.). Outlet shall be O-ring sealed. Saddles shall be ANSI/NSF 61 certified.
- C. Shall be Ford 202B (for DI pipe), or ROMAC 202N (for PVC and AC pipe), no equal.



## 2.6 WATER SERVICE CONNECTIONS AND FITTINGS

- A. Water service pipes shall be type K copper for buried service lines. Piping shall be 3/4-inch, 1-inch, or 2-inch minimum as indicated on the Contract Drawings. Replacement service pipes shall be the same diameter as existing pipes.
- B. All water service connections, except 2-inch, shall be made using **Mueller Insta-Tite Connections, Ford Ultra-Tite**, or approved equal, fittings and shall conform to AWWA C800. All 2-inch water service connections shall be made using **Mueller Pack Joint, Ford Pack Joint**, or approved equal.
- C. If the existing service is poly pipe, a coupling can be used to extend the poly service to the new waterline.
- D. New water service lines shall be bored, jacked or augered under the existing pavement, gutters or sidewalks.
- E. Where the new service line will pass under an existing gas line, in order to prevent damage, the gas line shall be potholed and shall remain exposed until the service line is installed.

## 2.7 CORP STOPS

- A. Corp Stops shall be Brass Alloy 85-5-5-5 ASTM B62 and conform to the requirements of AWWA C800.
- B. Corp Stops shall be **Mueller H-15000, Ford F600**, or approved equal.

## 2.8 FIRE HYDRANTS

- A. Fire hydrants shall the dry-barrel type that meet or exceed ANSI/AWWA C502, latest revision. Rated working pressure shall be 250 psig, and the test pressure shall be 500 psig.
- B. The nozzle section, upper and lower standpipes and hydrant base shall be ductile iron.
- C. External surfaces above grade shall be factory coated with an epoxy primer and a two-part polyurethane top coating.
- D. The main valve closure shall be of the compression type, opening against the pressure and closing with the pressure. Nozzle section to be designed for easy 360° rotation by the loosening of no more than four bolts.
- E. The valve opening diameter shall be 5-1/4". Hydrant must be designed so that removal of all working parts can be accomplished without excavating. The bronze seat shall be threaded into mating threads of bronze for easy field repair.
- F. Bolting below-grade shall be stainless steel.
- G. The draining system of the hydrant shall be bronze and be positively activated by the main operating rod. Hydrant to be furnished with a sliding bronze drain valve. Sliding drain valves made of rubber, plastic or leather will not be allowed.

- H. Hydrant must have an internal travel stop nut located in the top housing of the hydrant.
- I. Hydrant operating threads to be factory lubricated. O-rings shall be furnished to help keep operating threads lubricated and protected from line fluid and from the weather.
- J. Hydrant must have a traffic flange design allowing for quick and economical repair of damage resulting from a vehicle's impact. Hydrants shall be **AMERICAN Flow Control's Waterous Pacer Model WB67-250**, or approved equal.

## 2.9 VALVE BOXES AND LIDS

- A. All buried valves shall be installed complete per APWA 574. Screw type valve box shall be manufacturer be **Tyler Union 6850 Series**, or approved equal. Slip type valve box shall be manufacturer be **Tyler Union 6855 Series**, or approved equal. The valve box lid shall be designated "WATER" unless noted otherwise on the Contract Drawings.
- B. Concrete Collars shall be 10" thick x 2'- 6" in diameter centered on the valve box. They shall have two circumscribing #4 bars, one at three inches from the outside edge and a second bar nine inches from the outside edge each centered in the concrete. Concrete shall be 3,000 psi.

## 2.10 PRESSURE GAUGES

- A. Pressure gauges shall be provided where shown on the drawings. Gauges shall meet the requirements of ASME B40.1 Grade 2A and be industrial type with stainless steel movement, liquid filled, and stainless steel, Polypropylene, or Phenolic case. Gauges shall have a rear blowout disc or panel. Unless noted otherwise on the drawings, pressure gauges shall have a 4-1/2-inch dial with white face and black lettering, a 1/2-inch threaded connection, and shut-off valve. The measuring element shall be a stainless-steel Bourdon Tube. Gauges shall be calibrated to read in applicable units, with an accuracy of  $\pm 0.5$  percent to 150 percent of the working pressure. Gauges shall be **Ashcroft Model 1279 Duragauge, 1900 Series SOLFRUNT by Ametek (U.S. Gauge), Process Gauge by Marsh Bellofram**, or approved equal.
- B. Gauges inside unheated spaces shall be **Ashcroft 1279 PLUS! Performance dry gauge**, or approved equal.
- C. Pressure gauges that connect to lines other than potable water shall have gauge guards to prevent corrosion and clogging. Gauge guards shall have a durable flexible diaphragm which serves as a protective barrier between the process fluid and instrument. The diaphragm shall be either elastomer or Teflon and rated for the pressure of the gauge.

## 2.11 PRESSURE REDUCING VALVES

- A. Pressure Reducing Valves shall automatically reduce higher inlet pressure to a steady lower downstream pressure, regardless of changing flow rate and/or varying inlet pressure. Each valve shall have an accurate, pilot-operated regulator capable of holding downstream pressure to a pre-determined limit. When downstream pressure exceeds the pressure setting of the control pilot, the main valve and pilot valve close drip tight. The valve shall be hydraulically operated, single diaphragm actuated, globe type valve. The valve stem and trim shall be AISI 316 stainless steel and the valve body shall be

ductile iron conforming to ASTM A536 (Grade 65/45/12). Pilot ends shall be threaded or Class 300 grooves and shall be rated for a working pressure of 250 psi. The valve manufacturer shall provide a 3-year warranty on the valve. The pressure reducing valve shall be **Model 90-01 by Cla-Val Company**, or approved equal.

1. Flanges shall comply with ANSI B16.1, Class 125/150.

- B. A direct factory representative shall provide start-up assistance, inspection, and adjustments. The representative shall provide 2 to 4 hours of assistance for each valve installed on the project.

## 2.12 HYDRAULIC CONTROL VALVE

- A. Hydraulic Control Valves shall be hydraulically operated, pilot-controlled, modulating valve designed to maintain constant upstream pressure within close limits. If downstream pressure increases above the spring setting, the valve shall close. The valve shall be hydraulically operated, single diaphragm actuated, globe type valve. The valve stem and trim shall be AISI 316 stainless steel and the valve body shall be ductile iron conforming to ASTM A536 (Grade 65/45/12). Pilot ends shall be threaded or Class 300 grooves and shall be rated for a working pressure of 350 psi. The valve manufacturer shall provide a 3 year warranty on the valve and 1 year warranty on the electrical components. The hydraulic control valves shall be **Model 100-01 by Cla-Val Company**, or approved equal, with the **Model XP2F-X35** data acquisition and flow metering package.

1. Flanges shall comply with ANSI B16.1, Class 125/150.

- B. The pressure relief pilot shall be a direct-acting, adjustable, spring-loaded, diaphragm valve designed to permit flow when controlling pressure exceeds the adjustable spring setting. Pilot control sensing shall be upstream of the pilot system strainer so accurate control may be maintained if the strainer is partially blocked. A full range of spring settings shall be available from 0 to 250 psi.
- C. A direct factory representative shall provide start-up assistance, inspection, and adjustments. The representative shall provide 2 to 4 hours of assistance for each valve installed on the project.

## 2.13 RUBBER FLAPPER SWING-FLEX CHECK VALVE

- A. Provide rubber flapper type swing-flex check valve, 250 psi rated, complying with AWWA C508, with flanges complying with ANSI B16.1, Class 125, having a valve body with full flow area equal to pipe nominal diameter at all points, and a seating surface on a 45-degree angle to minimize disc travel. Provide a stainless-steel disc closure accelerator.
- B. Valve body and cover shall be ASTM A536 Grade 65-45-12 ductile iron. Disc shall be precision molded Buna-N (NBR) ASTM D2000-BG. Valve shall be NSF 61 certified.
- C. Swing Check valve shall be **Valmatic Series 7200 Surgebuster**, or approved equal.

## 2.14 HOSE BIBBS and SAMPLING TAPS

- A. Hose bibbs shall be manufactured by **Watts**, or approved equal, and shall include an integral vacuum breaker or built-in backflow protection devices and cast iron wheel handle. Sampling Taps shall be smooth nose type. Valves shall be stainless steel or as indicated on the Contract Drawings.

## 2.15 COMBINATION AIR VALVES (LOW SEATING)

- A. Combination Air Valves shall be single body, double orifice valves conforming to the requirements of AWWA C 512. Valves shall be the size indicated on the Contract Drawings and shall be **Model C70 by Bermad**, or approved equal.

## 2.16 COMBINATION AIR VALVES

- A. Combination Air Valves shall be ductile iron ASTM A536 Grade 65-45-12 single body, double orifice valves conforming to the requirements of AWWA C 512. Valve float and trim shall be stainless steel. Valves shall be the size indicated on the Contract Drawings and shall be **Series 140C by APCO (DeZURIK)**, or approved equal.

## 2.17 INSULATING JOINTS

- A. General: Insulating joints shall be dielectric unions or flanges. The complete assembly shall have an ANSI rating equal to or higher than that of the joint and pipeline. All materials shall be resistant for the intended exposure, operating temperatures, and products in the pipeline.
- B. Insulating Flanges:
  - 1. Gaskets:
    - a. Full-face, fiberglass (G10) with O-ring seal gasket. Buried insulating flanges shall be full face gaskets only.
    - b. Complete assembly shall have an ANSI rating equal to the flanged joint.
    - c. Gasket materials shall be resistant to intended chemical exposure, operating temperatures, and pressures in the pipeline.
  - 2. Insulating Sleeves: Full-length Mylar or fiberglass reinforced epoxy (NEMA G-10 grade).
  - 3. Insulating Washers: Fiberglass reinforced epoxy (NEMA G-10 grade).
  - 4. Steel Washers: Plated, hot-rolled steel, 1/8-inch thick.
  - 5. Manufacturer or approved equal:
    - a. GPT industries, Houston, TX.
    - b. Advanced Products and Systems, Scott, LA
    - c. Central Plastics Co., Shawnee, OK.
- C. Insulating Pump Barrel Kits
  - 1. Custom fabricated, full-face, fiberglass (G10) sheet to match pump discharge head and pump barrel sole plate as shown on Drawings.
  - 2. All washers and sleeves for bolt quantity and sized as provided by pump discharge head manufacturer.
  - 3. Insulating washers and sleeves shall be G10 Fiberglass

4. Insulating sheets, washers, and sleeves shall be provided on all pump barrels, including future pump barrels.

- D. Insulating Unions: O-ring sealed with molded and bonded insulating bushing to union body, as manufactured by Central Plastics Company, Shawnee, OK; or approved equal.

## **2.18 FLOW METER**

- A. See Section 40 91 23 – Miscellaneous Properties Measurement Devices.

## **2.19 PRESSURE TRANSMITTERS**

- A. See Section 40 91 23 – Miscellaneous Properties Measurement Devices.

## **2.20 DYNAMIC SETTLEMENT JOINTS**

- A. Dynamic settlement joints shall be designed to handle in-service movement during seismic events and shall be able to accommodate 2-inches of differential settlement. Assemblies shall be NSF 61 certified. All joint assemblies shall be rated for 150 psi.
- B. Mechanical Grooved Coupling Style
  1. Assembly shall withstand the full end thrust load and in-service dynamic movement via pairs of self-restraining grooved type couplings.
  2. Grooved ends shall be compliant with AWWA C 606 and AWWA C 200.
  3. The housing shall be ductile iron to ASTM A 536 Grade 65-45-12 or ASTM A 395 Grade 65-45-15. Couplings shall be groove and retaining ring style, designed to meet the requirements of AWWA M11 for differential settlement. Joint seals shall be EPDM. Bolts shall be ASTM A 193 Grade B8M Class 2 stainless steel. Pipe spools shall be constructed from ASTM A 53 and shall meet the requirements of AWWA C 200. Forgings/rings shall be constructed from ASTM A 105. Coating and lining shall be epoxy in accordance with AWWA C 210.
  4. The manufacturer shall provide in-person training for proper installation of couplings and shall provide installation inspection and QA procedures to ensure joint integrity and proper installation.
  5. Mechanical grooved coupling type dynamic settlement joint assemblies shall be **Style W257B, W257, or 257 by Victaulic Company.**

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Valves, valve-operating units, stem extensions and other accessories shall be installed by CONTRACTOR where shown, or where required in the opinion of ENGINEER, to provide for convenience in operation. Where buried valves are indicated, CONTRACTOR shall furnish and install valve boxes at grade with concrete collars. All valves and boxes shall be new and recently manufactured.
- B. Install mechanical appurtenances as indicated in the Contract Drawings and in accordance with the manufacturer's written instructions.

### **3.2 DYNAMIC SETTLEMENT JOINTS PREPARATION**

- A. Check all pre-installed couplings prior to installation to verify that all sets of hardware are tightened completely and that metal-to-metal bolt pad contact is present at all bolt pads. Refer to the installation instructions that are supplied with the coupling.
- B. Before placing the unit for installation, verify that the two existing pipe end connections are concentric and colinear along their centerline. Measure the space between the two pipe ends and verify that it corresponds to the 'Installed Length' that is marked on the side of the Victaulic Dynamic Movement Joint.
- C. The existing pipe end connections shall remain fixed in order to maintain the 'Installed Length'.
- D. Measure the length of the Victaulic Dynamic Movement Joint to verify that it corresponds to the appropriate 'Set Length'. If the measured length is shorter than the appropriate 'Set Length', expand the Victaulic Dynamic Movement Joint until the appropriate 'Set Length' is achieved. If the measured length is longer than the appropriate 'Set Length', compress the Victaulic Dynamic Movement Joint until the appropriate 'Set Length' is achieved.
- E. Pre-install a gasket from each end coupling onto the end of each existing pipe end connection. Refer to the installation instructions that are supplied with the coupling.

### **3.3 DYNAMIC SETTLEMENT JOINTS INSTALLATION**

- A. Lift the Victaulic Dynamic Movement Joint slowly while guiding it into place in the pipeline. Verify that the weight of the Victaulic Dynamic Movement Joint remains balanced as it is lifted and moved into position.
- B. Bring the Victaulic Dynamic Movement Joint into position between the two existing pipe end connections. To prevent damage to coatings and linings, DO NOT allow the Victaulic Dynamic Movement Joint to impact the two existing pipe end connections. Verify that the two existing pipe end connections and the Victaulic Dynamic Movement Joint are concentric and colinear and that the pipe ends are square to the Victaulic Dynamic Movement Joint.
- C. Provisions shall be made for supporting the Victaulic Dynamic Movement Joint throughout the entire installation process and for maintaining the 'Set Length'. If the 'Set Length' changes during the lifting process, the Victaulic Dynamic Movement Joint shall be either compressed or expanded to correspond to the marked 'Set Length' prior to installation of the end couplings.
- D. After the Victaulic Dynamic Movement Joint is in position (at the marked 'Installed Length' and concentric, colinear, and square to the two existing pipe end connections), install the end coupling connections. Refer to the installation instructions that are supplied with the coupling.
- E. FOR BURIED APPLICATIONS: The trench bed shall be prepared to ensure that continuous support is provided under the pipe and couplings. The haunching material, which is found in the area between the bedding and the underside of the pipe, shall be worked in and compacted before continuing backfill. Haunching shall have no voids,

and the backfill material shall not be contaminated with debris or other foreign materials that could damage the pipe or cause loss of support. All backfill shall be consistent and meet application-site specifications. The complete assembly shall be wrapped with ductile iron pipe poly wrap to prevent aggregate from entering the grooves adjacent to the coupling keys.

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**SECTION 33 13 00**  
**PIPELINE TESTING AND DISINFECTION**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This section covers testing and disinfection in order to remove bacteriological contamination of the pipeline. Disinfection is only required if the pipeline is used for potable water.
- B. CONTRACTOR shall be responsible for obtaining permits for discharging excess testing water and dechlorination of such water, if required.
- C. Hydrostatic testing shall meet the requirements of this Section, or the requirements provided in each individual pipeline Section, whichever is more stringent.
- D. If there is a discrepancy between this Section, the individual pipe Sections, or applicable AWWA Standards, the more stringent requirement shall apply.

**1.2 RELATED SECTIONS**

- A. Related Work specified in other Sections includes but is not limited to:
  - 1. Section 01 33 00 Submittal procedures
  - 2. Section 33 05 05 Ductile Iron Pipe
  - 3. Section 33 05 03 Copper Pipe

**1.3 REFERENCES**

- A. The Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publications are referred to in the text by basic designation only.
  - 1. AWWA C 600 Standard Installation of Ductile-Iron Mains and Their Appurtenances
  - 2. AWWA C 604 Standard Installation of Buried Steel Water Pipe – 4-inch (100mm) and larger
  - 3. AWWA C 605 Standard Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
  - 4. AWWA C 651 Standard for Disinfecting Water Mains
  - 5. UAC R309-550-8 Installation of Water Mains

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Furnish a written testing plan and schedule, including water source and methods for conveyance to the project, sequence, control, and disposal. Include the name of the certified bacteriological testing laboratory.
- C. Disinfection Report:

1. Type and form of disinfectant used.
2. Date and time of disinfectant injection start and time of completion.
3. Test locations.
4. Name of person collecting samples.
5. Initial and 24 hour disinfectant residuals in treated water in parts per million (ppm) for each outlet tested.
6. Date and time of flushing start and completion.
7. Disinfectant residual after flushing in ppm for each outlet tested.

## **PART 2 MATERIALS**

### **2.1 DESCRIPTION**

- A. All test equipment, temporary valves, bulkheads, and other water control equipment shall be as determined by CONTRACTOR. No materials shall be used which damage the project pipelines for future conveyance of potable water.
- B. Disinfecting materials shall consist of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. Dechlorination agents may be sodium bisulfate, sodium sulfite, or sodium thiosulfate.

## **PART 3 EXECUTION**

### **3.1 GENERAL**

- A. Source of Water
  1. CONTRACTOR shall assume all responsibility to obtain the necessary water for testing and disinfection of the water line system. All testing water used in the pipeline shall be potable water from a State approved drinking water system.
  2. All pressure pipelines shall be tested.
  3. Disposal of flushing water and water containing chlorine shall be by methods acceptable to the State of Utah, Division of Water Quality.

### **3.2 HYDROSTATIC TESTING OF PIPELINES PROCEDURE**

- A. Prior to hydrostatic testing, pipelines 24-inches diameter and larger shall be swept free of debris and visually inspected that all debris has been removed prior to filling.
- B. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. CONTRACTOR may test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline. Where such valves are not present, CONTRACTOR shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate one-mile segments. Sections that have a zero-leakage allowance may be tested as a unit. No section of the pipeline shall be tested until field-placed concrete or mortar has attained an age of 14 Days. The test shall be made by closing valves when available or by placing bulkheads and filling the line slowly with water (maximum filling velocity shall not exceed 0.25 foot per second, calculation based on the full area of the pipe). CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the

thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. CONTRACTOR shall provide sufficient temporary tapplings in the pipelines to allow for trapped air to exit or for water to be drained. After completion of the tests, such taps shall be permanently plugged. Care shall be taken that air relief valves are open during filling.

- C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. After the pipeline or section thereof has been filled, it shall be allowed to stand under a slight pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to ENGINEER shall be taken. Additional water shall be added to the pipeline to replace any water absorbed by the cement mortar lining.
- D. The hydrostatic test shall consist of holding 125% of the working operating pressure on the pipeline segment for a period of 2 hours. For projects with long pipeline segments, the test pressure shall not be less than 125% of the design operating pressure at the highest elevation on the pipeline and shall not be less than 150% of the working operating pressure at the lowest elevation on the pipeline. The test pressure shall never exceed the pipe of thrust-restraint design pressure or the pressure rating of the pipe unless allowed per the type of pipe specifications.
- E. Visible leaks that appear during testing shall be repaired regardless of the amount of leakage.
- F. Add water to restore the test pressure if the pressure decreases 5 psi below test pressure during the test period. Record the amount of water added.
- G. Pipe with welded joints shall have no leakage. In the case of pipelines that fail to pass the leakage test, CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.
- H. Exposed piping and valves shall show no visible leaks and no pressure loss during the test.
- I. Blowoff isolation gate valves and plug valves (throttling valves) shall be operated and tested during a simulated blow down operation to demonstrate functionality of the valves to the satisfaction of ENGINEER. Isolation valves (gate valves) shall not be used for throttling.
- J. CONTRACTOR shall test all piping either in sections such that dissimilar pipe materials shall not be tested together, or the more stringent leakage allowance shall hold for whole section of tested piping, regardless of pipe material.

K. Ductile Iron Pipe Gasketed Joints Pipeline Pressure and Leak Test

1. Hydrostatic testing for Ductile Iron pipe shall be in accordance with the requirements of AWWA C 600 and this Section. In case of a conflict between these two references, the more stringent requirement shall be followed.
2. The test shall be made by placing temporary bulkheads as needed in the pipe and filling the line slowly with water. Care shall be taken to see that all air vents are open during the filling. Bulkheads, valves, and connections shall be examined for leaks. If any leaks are found, corrective measures satisfactory to ENGINEER shall be taken. The test shall consist of holding a minimum pressure as shown above or on the Contract Drawings on the section being tested for a minimum period of two hours using either pneumatic or hydraulic means to maintain the pressure. Suitable means shall be provided by CONTRACTOR for determining the quantity of water lost by leakage under the test pressure. The testing allowance is defined as the quantity of water that must be applied to the pipe section being tested to maintain a pressure within 5 psi of the specified hydrostatic test pressure. The maximum allowable leakage shall be defined as follows:

$$L = SD\sqrt{(P)/148,000}$$

L = Testing allowance (makeup water) in gallons per hour of test

S = Length of pipe tested in feet

D = Nominal diameter of pipe in inches

P = Average Test Pressure in pounds per square inch (gauge)

**3.3 DISINFECTING OF PIPELINES PROCEDURE**

- A. Leakage and pressure testing must be completed prior to disinfection procedures.
- B. All water and solution piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the AWWA C 651.
- C. CONTRACTOR may use one of the three chlorination methods – tablet, continuous feed, and slug, as outlined in AWWA C 651 that is acceptable to OWNER. Care must be taken to prevent the strong chlorine solution in the pipe being disinfected from flowing back into the line supplying the water.
- D. CONTRACTOR shall provide sampling ports along the pipeline as defined in AWWA C651. Taps may be at manways and air valves to help facilitate the spacing requirement.
- E. Heavily chlorinated water shall not be discharged onto the ground. Upon completion of disinfection, Sodium Bisulfate (NaHSO<sub>4</sub>), or other approved dechlorination agent, shall be applied to the heavily chlorinated water to neutralize thoroughly the chlorine residual remaining. Water shall be neutralized to less than 1 ppm total chlorine residual.
- F. After approval of disinfection, CONTRACTOR shall flush the new system until the chlorine residual is a maximum of 0.3 ppm.
- G. After final flushing and before the new water main is connected to the distribution system, two consecutive sets of acceptable samples, taken at least 24 hours apart, shall be collected from the pipeline being tested. Sampling and testing will be completed by

CONTRACTOR. CONTRACTOR shall collect at least one set of samples from every 1,200 feet of pipeline, plus one set from the end of the line and at least one set from each branch. All samples shall be tested for bacteriological (chemical and physical) quality in accordance with "Standard Methods for Examination of Water and Wastewater" and shall show the absence of coliform organisms. If the initial disinfection fails to provide satisfactory bacteriological results, or shows the presence of coliform, then the line shall be re-chlorinated, flushed, and retested until satisfactory results are obtained at the expense of CONTRACTOR.

### **3.4 CONNECTIONS TO EXISTING SYSTEM**

- A. Where connections are to be made to an existing potable water system, the interior surfaces of all pipe and fittings used in making the connections shall be swabbed or sprayed with a one percent hypochlorite solution before installation. Thorough flushing shall be started as soon as the connection is completed and shall be continued until discolored water is eliminated.
- B. Final Fill: After successful pressure and disinfection tests, the pipeline(s) shall be filled with fresh potable water and shall remain filled.

- END OF SECTION -

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**SECTION 33 15 20**  
**FLEXIBLE FABRIC REINFORCED PIPE**

**PART 1 GENERAL**

**1.1 INTENT**

- A. It is the intent of this specification to provide for the reconstruction of the designated pressure pipe by the installation of an aramid (Kevlar) Flexible Fiber-Reinforced Pipe (FFRP) within the existing host pipe. Due to the condition of the host pipe the new FFRP shall be designed as a fully independent, non-interactive and loose-fit pipe, not relying on the remaining strength of the host pipe to withstand long-term internal pressure. When the piping system is intended for the conveyance of potable water, the proposed product shall be certified as complying with the requirements of NSF/ANSI 61. Material and installation requirements are specified in the following subsections.

**1.2 SUMMARY OF WORK**

- A. This work consists of host pipe cleaning, CCTV inspection, and lining the existing 18-inch diameter cast iron water main with the FFRP system; all in accordance with these Specifications, the Contract Drawings, manufacturer's instructions, and any other regulatory requirements. This work requires coordination of work between OWNER, ENGINEER, and CONTRACTOR.
- B. The FFRP System includes both the FFRP Liner Material, and the FFRP Connectors.
- C. The work shall be done as described in the Contract Drawings.

**1.3 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures

**1.4 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN WATER WORKS ASSOCIATION (AWWA)
1. AWWA C 207 Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
2. AWWA C 651 Disinfecting Water Mains
3. AWWA C 751 Magnetic Inductive Flowmeters
4. AWWA M28 Rehabilitation of Water Mains
- C. NSF INTERNATIONAL (NSF)
1. NSF/ANSI 61 Drinking Water System Components - Health Effects
- D. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

1. F 2786 Standard Practice for Field Leak Testing of Polyethylene (PE) Pressure Piping Systems Using Gaseous Testing Media Under Pressure (Pneumatic Leak Testing)

## **1.5 SUBMITTALS**

- A. Submit specifications and shop drawings for materials and equipment furnished under this section in accordance with Section 01 33 00 – Submittal Procedures
- B. Submit all required documents of Section 2.
- C. Submit manufacturer's liner and end connector data/cut sheets.
- D. Submit Manufacturer's Engineering project feasibility review, design, and Standard Operating Procedure.
- E. Submit Manufacturer's Certificate: Prior to first shipment of FFRP, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the testing specification standards specified herein. Certify that all products furnished meet or exceed specified requirements herein.
- F. Submit manufacturer's requirements for receiving, handling, and storage of materials.
- G. Submit detailed description and requirement for preparing existing host pipe for lining, liner and end connector installation procedures.
- H. Submit CCTV Inspection video and report of the existing pipe condition, pipe bends, joints and location of existing valves, tees, and appertencies after cleaning, prior to authorization to line.
- I. Submit all field installation and test reports.
- J. Submit warranty from the FFRP manufacturer certifying that the FFRP system shall be free from defects in material and workmanship under normal and proper use and service, for a period of five (5) years after startup and acceptance by OWNER. CONTRACTOR shall provide all labor and materials to repair or replace any defective warranted items specified in this section.

## **PART 2 PRODUCT**

### **2.1 MANUFACTURER/INSTALLER QUALIFICATION REQUIREMENTS**

- A. The pipelining materials shall be Primus Line® as manufactured and supplied by Rädlinger Primus Line, GmbH. or ENGINEER approved equal. Only pipelining materials in conformance with the requirements of this contract document shall be considered as an "or equal" for this item.
- B. Any product not complying with these specifications for any reason must be pre-approved prior to the formal opening of bids. No later than two weeks before the formal proposal due date, each proposer shall submit to OWNER the required prequalification submittals designated in PART 2, PART 3, and PART 4 of this specification to be considered and approved as an "or equal." The proposer is hereby made aware that the specified product in this contract document has been thoroughly vetted and has met the



technical qualifications and capabilities needed for the project. After the evaluation of the data, OWNER will notify those firms that have produced acceptable submittal packages that they are qualified to furnish proposals for this project and shall be accepted by addendum. OWNER's decision shall be final.

C. The Installer of the FFRP liner:

- a. Must satisfy all insurance, financial, and bonding requirements of OWNER.
- b. The installation crew must be trained and certified by the manufacturer of the product being installed and shall submit their certifications.
- c. Must have at least (3) years of active experience installing the intended FFRP system bid and as specified in the contract documents, and
- d. At least 5 (five) similar installations of pressure rated FFRP in a similar application, size and length as indicated in these Contract Documents.
- e. Acceptable documentation supporting the above must be submitted to OWNER with the bid.

D. To be Commercially Proven, the Manufacturer must have had at least 5 (five) years active experience and a minimum of 150,000 linear feet of commercial installation of pressure rated aramid (Kevlar) FFRP products in pressure pipe applications in the United States and Canada. Acceptable documentation supporting the above must be submitted to OWNER with the bid.

### **PART 3 MATERIALS**

A. The pipelining system specified herein is a material and methods product as manufactured and specified by Rädlinger Primus Line GmbH, Kammerdorfer Str. 16, 93413 Cham, Germany. Material and installation requirements are specified in the following subsections. The proposer is hereby made aware that the specified product in this contract document has been thoroughly vetted and has met the technical qualifications and capabilities needed for the project.

B. Materials for water systems shall meet the appropriate American Water Works Association (AWWA) standards and American National Standards Institute (ANSI) specifications, and be NSF 61 certified, except non-potable water applications as modified by these specifications.

C. Materials that are defective, damaged, or otherwise deemed unacceptable for use prior to installation shall be rejected and replaced at CONTRACTOR's expense. Materials damaged during installation shall be repaired or replaced as recommended by CONTRACTOR and approved by OWNER.

D. Flexible Fabric Reinforced Pipe (FFRP):

1. The FFRP shall be as manufactured and specified by Rädlinger Primus Line GmbH, Kammerdorfer Str. 16, 93413 Cham, Germany to meet the requirements of the pipeline.
2. The FFRP shall be a thermoplastic pipe that is reinforced with aramid (Kevlar) fiber or hybrid reinforcement containing polyester and aramid (Kevlar) fiber woven yarns. No substitutes will be approved.

3. The FFRP Composite shall be constructed of (3) or more distinct layers by a single extrusion process. The layers shall have a distinct individual uniform thickness and meet or exceed the specified internal pressure requirement in Section 4.A.
  - a. Outer Layer: shall be made of an abrasion-resistant polyethylene PE or TPU. The outer PE layer shall be UV resistant.
  - b. Reinforcement Layer: shall be a seamless continuous twill of woven aramid (Kevlar®), either one or two layers depending on the required pressure.
  - c. Inner layer: shall be made of PE or TPU based on media transported.
4. The FFRP shall be clearly marked with the following information:
  - a. Nominal composite liner diameter.
  - b. Fluid and maximum operating pressure for the transported fluid.
  - c. Trade name/trademark.
  - d. Year, Month, and Day of manufacture in the format YYYY.MM.DD.
  - e. FFRP batch number.
  - f. Continuous production run length in feet with the units labelled.
5. There shall be no bonding to the host pipe and no interaction with the host pipe once installed. The outside diameter of the FFRP shall be reduced for a loose-fit within the host pipe with a continuous annular gap and shall be pressure rated to meet or exceed the pressure requirements in Section 4.A independently of the host pipe being rehabilitated. Close-fit and or interactive products which apply radial stresses on the host pipe will not be accepted.
6. Bend Traversing Capability:
  - a. The FFRP shall be capable of passing through bends.
  - b. The FFRP shall be capable of passing a 90° bends with approval of the manufacturer.
7. Hydraulic Capacity:
  - a. The C-factor for the FFRP shall be 150.
  - b. All layers of the FFRP shall be between 0.24 inches to 0.32 inches thick.
  - c. The FFRP shall provide a minimum design life of 50 years.
8. The FFRP shall be pressure rated and tested to meet or exceed the pressure requirements independently without interacting with the pipeline being rehabilitated. The pressure class of the FFRP shall be determined by long-term and short-term pressure testing for the core reinforcement layer used. Testing results shall be submitted for verification. See Table 33 15 20-1 for acceptable short-term burst (STBP) minimums.

Table 33 15 20-1: Minimum Short-term Bust of Core Reinforcement

Pressure Class	Diameter (inches)	Core Reinforcement	Wall Thickness Inches (mm)	Minimum Short-term Burst (STBP)
Low	6 - 16 in.	Single-layer Aramid & Polyester	0.24 (6 mm)	435 psi
Medium	6 – 20 in.	Single-layer Aramid	0.24 (6 mm)	580 psi
High	6 – 16 in.	Double-layer Aramid	0.31 (8 mm)	1,189 psi

9. The FFRP shall be marked for a distance at regular intervals along its entire length, not to exceed 5 feet. Such markings shall include the Manufacturers name, production lot and intended use or identifying symbol. Where applicable, the tube shall be marked "NSF 61" in accordance with the NSF protocol.

**E. FFRP End Connectors:**

1. The FFRP end connectors shall be as manufactured and specified by Rädlinger Primus Line GmbH, Kammerdorfer Str. 16, 93413 Cham, Germany to meet the requirements of the pipeline and the FFRP specified in this contract document.
2. The End connector shall be constructed of cast iron, carbon steel or stainless steel and be designed to encapsulate and terminate the ends of the FFRP and provide a flanged or welded point for tie-ins.
3. The end connectors shall be pressure rated for the application and consist of an inside core, an external sleeve and equipped with 150/300 psi ANSI flanges for each section. The connector shall be designed according to the pressure of the FFRP used in the rehabilitation.
4. FFRP end connectors are manufactured from either cast iron, carbon steel or stainless steel. Connectors are both available with flanges or welded ends. While models with welding ends are not coated, models with flanges have a full-surface, high quality epoxy coating, which provide corrosion protection on all sides. The internal core of the high-pressure connector is made of stainless steel. Flanges used by FFRP comply with ANSI B16.5 or AS4087. All connectors preserve the overall integrity and function of the liner.
5. The end connectors shall be installed according to the Manufacturer installation specifications by a trained and certified technician.
6. The FFRP and end connector as part of the lining systems shall be from the same system manufacturer and designed and tested for compatibility. When tested together, the system shall meet or exceed the pressure requirements of the rehabilitated pipeline.
7. The supplier of all materials shall be an ISO 9001 certified producer or have implemented a quality system similar to that in the ISO 9001 requirements.
8. All materials that come in contact with potable water shall comply with applicable requirements of NSF/ANSI/CAN Standard 61 and indicated by a current listing by an ANSI accredited certification or testing agency when required by the authority having jurisdiction or other international requirements as applicable.

**PART 4 DESIGN REQUIREMENTS**

**A. The FFRP shall be designed with the following projects design parameters**

- |                                       |                   |
|---------------------------------------|-------------------|
| 1. Host Pipe Outside Diameter (OD):   | Supplied by OWNER |
| 2. Host Pipe Internal Diameter (ID):  | Supplied by OWNER |
| 3. Host Pipe Material:                | Cast Iron         |
| 4. Existing Host Pipe Lining/Coating: | None              |
| 5. Transported Fluid:                 | Drinking Water    |
| 6. Internal Operating Pressure:       | 10 – 60 psi       |
| 7. Maximum Operating Pressure:        | 150 psi           |
| 8. Test Pressure:                     | 200 psi           |
| 9. Operating Temperature:             | 55 deg F          |

10. Degree and Radius of Bends:	See design drawings
11. Position of Bends:	See design drawings
12. Host Pipe Location & Profile:	See design drawings**

\*\* Site plans provided by OWNER shall indicate service or branch connections, Tees, valves, hydrants, horizontal and vertical bends, that are located on the host pipe section or length to be rehabilitated.

- B. The FFRP shall be designed to assume no bonding to the host pipe wall and withstand all internal pressure without interaction with the host pipe for its design life according to EN ISO 11295.
- C. FFRP shall be designed to be operated as an independent pipe within the host pipe with a minimum design life of 50 years.

## **PART 5 INSTALLATION**

### **5.1 CLEANING AND CCTV INSPECTION**

Water necessary for cleaning, disinfection, and flushing will be available, at no cost, from locations (fire hydrants) indicated by OWNER prior to the start of work. The water source provided shall be in close proximity to lines being worked on. CONTRACTOR shall arrange with OWNER, for issuance of an approved combination meter and backflow prevention device. CONTRACTOR shall provide necessary piping or flexible hoses and fittings, for connection between fire hydrant and end of pipe section where water is required. OWNER shall provide a location at no cost to CONTRACTOR (e.g., sanitary sewer, etc.) for proper disposal of water after use.

- A. Cleaning Pipelines: CONTRACTOR shall remove all internal debris and tuberculation from the host pipeline that will interfere with the installation of the FFRP or be detrimental to the final product. ALL WATER shall BE SUPPLIED BY OWNER
- B. Removal of Obstructions and Protrusions: All obstructions and protrusions shall be removed that could be detrimental to the final product and brought to the attention of the Manufacturer, OWNER or ENGINEER prior to the FFRP insertion for correcting. Where inspection reveals an obstruction or protruding weld seam that cannot be removed by conventional remote equipment and practice, a point repair excavation shall be made to uncover and remove or repair the obstruction prior to the installation of the FFRP.
- C. Host Pipe Failures: If any host pipe failures have occurred prior to the installation of the modified FFRP or are revealed through internal inspection that would inhibit installation or the operation of the pipe they shall be recorded and brought to OWNER's representative to evaluate and correct as necessary by external or internal point repairs prior to lining.
- D. Confirmation of Bends: The location, radius and position of bends shall be noted and brought to the attention to the Manufacturer, OWNER or ENGINEER for lining approval.
- E. CCTV Inspection: A video inspection shall log and confirm the adequacy of the cleaning and removal of all debris, tuberculation, obstructions, protrusions and the confirmation of radius of bends within the section.

1. All appertencies, i.e., valves, tees, services etc. shall be noted on the inspection log and brought to the attention of the Manufacturer, OWNER or ENGINEER for lining approval.
2. The inspection video and logs shall be submitted to OWNER for lining approval.

## **5.2 INSTALLATION**

The method for installation shall be the modified sliplining method per AWWA M28 and be in accordance with the latest edition of the Manufacturer's Installation Manual. The installation shall be performed by a trained and certified Installer.

FFRP Insertion:

- A. The reel of modified FFRP is positioned at the insertion point (a manhole, chamber, excavated pit or shaft that serves as the point of entrance for the insertion of the modified pipe into the existing pipe) and an appropriately sized winch at the destination point (a chamber, excavated pit or shaft that serves as the point of exit for the modified pipe from the existing pipe).
- B. The winch cable shall be strung through the host pipe and attached to the pulling head with an anti-twist device to prevent the FFRP from twisting while being inserted. The FFRP shall be pulled through the host pipe via the winch located at the destination point.
- C. Pulling forces shall be monitored, recorded and limited so as not to exceed the axial strain limits of the FFRP. The manufacturer shall provide information on the maximum allowable tensile stress of the FFRP and the appropriate pulling device (pulling head or a steel cable) needed for the liner being installed.
- D. Lubricant: The use of a non-toxic lubricant, suitable for drinking water if required, during the insertion is required to reduce friction during the insertion. The lubricant shall not support the growth of bacteria and will not adversely affect the fluid to be transported. The lubricant can be swabbed or sprayed applied or by other means.
- E. The FFRP shall be reverted to its original round shape using forced air pressure when applied to a rubber flow-through plug. The pressure shall be contained within the FFRP by a rubber stopper plug at the termination point and processed in accordance to the Manufacturer's Installation Manual. Internal pressure shall not exceed 14.5 psi.
- F. Upon completion of the insertion and re-rounding process of the FFRP, end connectors shall be installed by a trained and certified technician at the termination ends of the FFRP in accordance to the Manufacturer's Installation Manual and provide a flanged or welded point for tie-ins.

## **PART 6 HYDROSTATIC PRESSURE AND LEAKAGE TESTING / PRESSURE TESTING**

- A. The FFRP shall be subjected to a hydrostatic pressure test in accordance with OWNER's requirements. In the absence of OWNER requirements, a recommended pressure and leakage test shall be at 1.5 the known working pressure or at working pressure plus 50 psi, whichever is less.
- B. Hydrostat and Main Pressure tests in water and wastewater pipeline applications must be executed with water.

C. Hydrotest Preparation & Procedures:

1. The FFRP-lined section of the pipeline to be tested must be filled with water and air-free. In the case of potable water applications, disinfectants may be added if required.
2. Apply the pre-determined test pressure, and rest for 5 (five) minutes.
3. After the 5-minute rest period with pressure drop, the test pressure must be reapplied by pumping. The pumping process must be repeatedly applied with 5-minute rest period intervals. The pressure drop should decline after each repetition compared to the pressure drop measured from the step before.
4. The test pressure should be reapplied every 5 minutes until the pressure drop "after 5-minute period" is 0.23 PSI maximum.

D. Main Pressure Test:

1. Main pressure test shall begin after completion of hydrotest in 6.C.
2. Main pressure test must be executed for 2 (two) hours.
3. Main pressure test is considered successful if the pressure loss does not 3 PSI/hour. Hence after the 2-hour period, the pressure loss must not exceed 6 PSI.

E. Leakage Allowance

1. There is no leakage allowance for a section of FFRP, because when properly made in continuous lengths and installed with approved connectors, it does not leak. Other types of joints or connections in the system may have a leakage allowance. Contact the joint or connection manufacturer for information.
2. NOTE: If the installed system needs to transport liquid media it shall be assessed with water (hydrostatic pressure testing). If the installed system needs to transport a gaseous media, it should be evaluated with compressed air in accordance with F2786.

**PART 7 ACCEPTANCE TESTING**

- A. The FFRP shall be deemed acceptable when the installation is performed according to Section 5 and the applicable tests according to Section 6 are satisfied.
- B. The finished lining shall be continuous over the entire length and be impervious and free of any leakage from the pipe to the surrounding ground.

**PART 8 DISINFECTION OF THE PIPELINE FOR POTABLE WATER**

- A. In potable water applications the rehabilitated system and all exposed sections of any other pipe and appurtenances of existing pipelines shall be cleaned, disinfected, and verified through bacteriological testing in accordance ANSI/AWWA C 651, unless otherwise specified in the contract documents or approved by OWNER.

**PART 9 WATER MAIN RECONNECTION AND CLEAN-UP**

- A. Upon project completion, OWNER or CONTRACTOR, as specified by contract documents or purchase order, shall return the piping system to service by closure of all access pits with appropriate pipe spools, valves, and other relevant pipe fittings.

- B. Upon acceptance of the installation, CONTRACTOR shall reinstate the project area affected by the operations.

- END OF SECTION -

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**SECTION 40 05 13.19**  
**STAINLESS STEEL PROCESS PIPING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall furnish and install all stainless steel process piping and appurtenances as shown and specified, and as required for a complete and workable piping system.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
1. Section 01 33 00 Submittal Procedures
  2. Section 33 12 00 Mechanical Appurtenances

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
1. ASME B 16.5 Pipe Flanges and Flanged Fittings
  2. ASME B 16.9 Factory-Made Wrought Butt Welded Fittings
  3. ASME B 16.11 Forged Fittings, Socket-Welding and Threaded
  4. ASME B 31.1 Power Piping
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
1. ASTM A 312 Standard Specification for Seamless, Welded, and Heavy Cold Worked Austenitic Stainless Steel Pipes
  2. ASTM A 403 Standard Specification for Wrought Austenitic Stainless Steel Piping and Fittings
  3. ASTM A 409 Standard Specification for Welded Large Diameter Austenitic Steel Pipe for Corrosive or High-Temperature Service
  4. ASTM A 778 Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products
- D. AMERICAN WELDING SOCIETY (AWS)
1. AWS D1.1 Structural Welding Code
- E. AMERICAN WATER WORKS ASSOCIATION (AWWA)
1. AWWA C 606 Grooved and Shouldered Joints
  2. AWWA C 651 Standard for Disinfecting Water Mains

## **1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.
- C. Submit shop drawings of pipe, fittings, supports and appurtenances showing compliance with this Section including necessary dimensions, details, pipe joints and material lists.
- D. Submit gasket material data including manufacturer's catalog indicating that the proposed product is suitable for each fluid of service application.
- E. Submit welders' qualifications in accordance with AWS D1.1.

## **PART 2 PRODUCTS**

### **2.1 STAINLESS STEEL PIPE**

- A. Stainless steel process pipe shall be in accordance with ASTM A 312, Type 316, seamless, Schedule 80S, with screwed fittings for sizes up to and including 3-inches and welded fittings for sizes 3-inches and larger. Flange fittings may be used for pipe diameters 2-inches and larger. Stainless steel process piping 12-inches and larger shall be in accordance with ASTM A 409 or ASTM A 778, Type 316, Schedule 80S, with welded or flanged joints.

### **2.2 PIPE JOINTS**

- A. Stainless steel pipe 3-inches and smaller shall have screwed ends with NPT threads. Screwed joints shall be up with Teflon tape. Stainless steel pipe 3-inches and larger shall have welded joints or flanges. Flanges shall have stainless steel nuts and bolts the same material type as the pipe. Where indicated on the Drawings, provide grooved ends for rigid or flexible mechanical couplings. Pipe grooving is only allowed for Schedule 40S or 80S pipe. For plain end stainless steel pipe use sleeve-type couplings where noted in the Contract Drawings.
- B. Flanged joints shall be in accordance with ASME B16.5 for the pressure class required for the project conditions or as indicated in the Contract Drawings. CONTRACTOR is responsible for providing the appropriate flanges required to connect stainless steel process pipes to equipment and other appurtenances. CONTRACTOR shall replace flanges that do not match the mating equipment or appurtenance at no additional cost to OWNER. Gaskets shall be ANSI 150 lb. full face, 1/8-inch thick Neoprene for water or wastewater service. Gasket material for chemicals shall be suitable for the chemical service.

### **2.3 FITTINGS**

- A. Threaded fittings shall be forged stainless steel fittings in accordance with ASME B 16.11.
- B. Socket welded fittings shall be forged stainless steel fittings in accordance with ASME B 16.11.

- C. Butt-welded fittings shall be wrought stainless steel fittings in accordance with ASTM A 403 and ASME B 16.9.
- D. Flanged fittings shall be in accordance with ASME B 16.5.
- E. Grooved fittings shall be wrought stainless steel conforming to ASTM A 403 and ASME B 16.9 and to AWWA C 606. Gasket material shall be suitable for the intended service.
- F. Fittings shall be in accordance with the pressure class shown in the Contract Drawings or have the same pressure rating as the pipe.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Stainless steel process piping shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- B. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00 – Mechanical Metal Supports. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- C. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Low points shall be provided with a drain valve.

### **3.2 PIPE PREPARATION**

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

### **3.3 PIPE JOINTS**

- A. Pipe threads shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape.
- B. Welded joints shall conform to the requirements of this Section and the recommendations of ASME B 31.1. Welding shall be done by skilled and qualified welders. Welders shall be qualified under the provisions of AWS D1.1. Machines and electrodes similar to those used in the work shall be used in qualification tests. Field welds shall be kept to a minimum by using couplings or shop fabrication as much as possible. Weld residue, oxide, and heat stain shall be removed by stainless steel wire brushes followed by cleaning with an agent, followed by complete removal of the agent. Cleaning agent shall be **BlueOne Pickling Paste 130 by Avesta**

**Finishing Chemicals, STAR Gel by Krystal Surface Solution**, or approved equal. Passivation must following the cleaning process using **FinishOne Passivator 630 by Avesta Finishing Chemicals, STAR Pass 1 by Krystal Surface Solution**, or approved equal. Following the manufacturer's instruction for the cleaning/pickling and passivation process.

- C. Grooved couplings shall be installed per the manufacturer's recommendations and shall conform to AWWA C 606.

### **3.4 INSPECTION AND TESTING OF PIPELINE**

- A. Completed stainless steel process piping systems shall be inspected for proper supports, anchorage, and damage to pipe, fittings, and coatings. Any damage shall be repaired by CONTRACTOR at no additional cost to OWNER.
- B. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- C. Source of Water
  - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- D. Testing Procedure
  - 1. Prior to enclosure or burying, piping systems shall be pressure tested as required on the Contract Drawings, for a period of not less than one hour, without exceeding the tolerances listed in the Contract Drawings. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. CONTRACTOR shall furnish test equipment, labor, materials, and devices.
  - 2. Leakage shall be determined by loss of pressure, soap solution, or other positive and accurate method. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
  - 3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
  - 4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

### **3.5 DISINFECTING**

- A. Disinfection shall be in accordance AWWA C 651 and the requirements of Section 33 13 00 - Pipeline Disinfection.

- END OF SECTION -

**SECTION 40 05 13.33**  
**BRASS PROCESS PIPING**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. CONTRACTOR shall furnish and install all brass process piping and appurtenances as shown and specified, and as required for a complete and workable piping system.
- B. This Section includes schedule 40 and 80 brass process pipe in accordance with ASTM B43.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 05 45 00 Mechanical Metal Supports (Pipe Supports)
  - 3. Section 31 23 15 Excavation and Backfill for Pipelines
  - 4. Section 33 12 00 Mechanical Appurtenances
  - 5. Section 33 13 00 Pipeline Testing and Disinfection

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
  - 1. ASME B1.20.1 Pipe Threads, General Purpose
  - 2. ASME B 16.15 Cast Bronze Threaded Fitting Class 125 & 250
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM B 43 Standard Specification for Seamless Red Brass Pipe, Standard Sizes
- D. AMERICAN WATER WORKS ASSOCIATION (AWWA)
  - 1. AWWA C 651 Standard for Disinfecting Water Mains

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit manufacturer's affidavit certifying product was manufactured, tested, and supplied in accordance with applicable references in this section together with a report of the test results and the date each test was completed.

- C. Submit shop drawings of pipe, fittings, supports, and appurtenances showing compliance with this Section including necessary dimensions, details, pipe joints and material lists.

## **PART 2 PRODUCTS**

### **2.1 BRASS PIPE**

- A. Brass pipe and fittings shall conform to ASTM B 43, regular wall thickness (Schedule 40), except that nipples and pipe of sizes 1-inch and smaller shall be extra strong (Schedule 80).
- B. Brass pipe joints shall be screwed ends with NPT threads. Screwed joints shall be made up with Teflon tape. Threads shall conform to ASME B1.20.1.
- C. All brass pipe and fittings shall be NSF 61 or NSF 372 certified.

### **2.2 FITTINGS**

- A. Threaded fittings shall be in accordance with ASME B 16.15.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. For buried pipelines, excavation and backfill of trenches and for appurtenances shall be in accordance with Section 31 23 15 - Excavation and Backfill for Buried Pipelines.
- B. Above ground brass process piping shall be installed in a neat and workmanlike manner, properly aligned, and cut from measurements taken at the Site to avoid interferences with structural members, architectural features, openings, and equipment. Exposed pipe shall afford maximum headroom and access to equipment, and where necessary, piping shall be installed with sufficient slopes for venting or drainage of liquids and condensate to low points.
- C. Piping shall be firmly supported with fabricated or commercial hangers or supports in accordance with Section 05 45 00. Where necessary to avoid stress on equipment or structural members, the pipe shall be anchored or harnessed. Expansion joints and guides shall compensate for pipe expansion due to temperature changes.
- D. Unless otherwise indicated, connections to fixtures, groups of fixtures, and equipment shall be provided with a shutoff valve and union, unless the valve has flanged ends. Unions shall be provided at threaded valves, equipment, and other devices requiring occasional removal or disconnection. Low points shall be provided with a drain valve.

### **3.2 PIPE PREPARATION**

- A. Prior to installation, each pipe length shall be carefully inspected, flushed clean of any debris or dust, and be straightened, if not true. Ends of threaded pipes shall be reamed and filed smooth. Pipe fittings shall be equally cleaned before assembly

### **3.3 PIPE JOINTS**

- A. Pipe threads shall be full and cleanly cut with sharp dies or molded. Joints shall be made with Teflon tape.

### **3.4 INSPECTION AND TESTING OF PIPELINE**

- A. Completed brass process piping systems shall be inspected for proper supports, anchorage, and damage to pipe, fittings, and coatings. Any damage shall be repaired by CONTRACTOR at no additional cost to OWNER.
- B. CONTRACTOR shall provide temporary blow-off valves and fittings as required to flush and disinfect new pipelines. Temporary blow-off valves and fittings shall be removed prior to placing pipeline into service.
- C. Source of Water
  - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection and/or pressure testing of the pipeline.
- D. Testing Procedure
  - 1. Prior to enclosure or burying, piping systems shall be pressure tested as required in the Contract Drawings, for a period of not less than one hour, without exceeding the tolerances listed on the Drawings. Where no pressures are indicated, the pipes shall be subject to 1-1/2 times the maximum working pressure. CONTRACTOR shall furnish test equipment, labor, materials, and devices.
  - 2. Leakage shall be determined by loss of pressure, soap solution, or other positive and accurate method. Fixtures, devices, or other accessories that would be damaged if subjected to the test pressure shall be disconnected and ends of the branch lines shall be plugged or capped as appropriate during the testing procedures.
  - 3. Leaks shall be repaired, and the piping shall be re-tested until no leaks are found.
  - 4. ENGINEER shall be notified at least 48 hours before the pipeline is to be tested so that ENGINEER may be present during the test.

### **3.5 DISINFECTING**

- A. Disinfection shall be in accordance AWWA C 651 and the requirements of Section 33 13 00 – Pipeline Testing and Disinfection.

-                      END                      OF                      SECTION                      -

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## **SECTION 40 10 00 - PROCESS CONTROL AND INSTRUMENTATION SYSTEM - GENERAL**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. Section includes:
  - 1. General requirements applicable to all process control work.
  - 2. The requirements of this Section apply to all components of the Software Systems unless indicated otherwise.
  - 3. General requirements for programming submittals.
- B. Related sections:
  - 1. The Contract Documents are a single integrated document, and as such all Divisions and Sections apply. It is the responsibility of the CONTRACTOR and its Subcontractors to review all sections to ensure a complete and coordinated project:
    - a. Items involving electrical, control, and instrumentation construction may be shown on Drawings or referred to in Specifications that do not apply specifically to electrical, control and instrumentation systems.
- C. The Programming Contractor shall program all PLC's and the SCADA system. The Programming Contractor shall provide all software as specified herein for programming the system. The Programming Contractor and the electrical contractor shall be responsible to test each device and loop to verify proper function of all equipment on the project, whether provided by the contractor or by the owner. They shall then work with the owner to test and commission the entire system as described herein. The programming contractor shall be present to test the I/O for each equipment subsystem. The I/O to the PLC systems shall be tested at this time. The programming contractor shall provide and install a simple testing routine in each PLC in order to verify all I/O is functioning properly. All I/O shall be tested from its respective field device to the software level in the PLC. If final PLC programming is complete at the time of testing, the final software programming shall be used to test each device
- D. The Programming Contractor shall design the operator interface graphics, human machine interface (HMI) graphics, PLC logic, and control systems hardware as specified herein.
- E. Contract Documents:
  - 1. General:
    - a. Contract documents consist of drawings, specifications, and other documents issued by the ENGINEER. The Drawings and Specifications are complementary and are to be used together in order to fully describe the Work, and requirements shown, written or reasonably inferred there from on one is considered as written, shown or implied in all. In the event work is called for in more than one place and there are conflicting requirements, the right shall be reserved to require the installation of the larger or the more expensive.
    - b. Schematic Diagrams:
      - 1) All controls are shown de-energized.
        - a) Schematic diagrams show control function only. Incorporate other necessary functions for proper operation and protection of the system.

- b) Control schematics are to be used as a guide in conjunction with the descriptive operating sequences found in the Drawings or Specifications. Combine all information and furnish a coordinated and fully functional control system program.

## **1.2 REFERENCES**

### **A. Code Compliance:**

1. The publications are referred to in the text by basic designation only. The latest edition accepted by the Authority Having Jurisdiction of referenced publications in effect at the time of Bid governs.
2. The following codes and standards are hereby incorporated into these Specifications:
  - a. National Fire Protection Association (NFPA):
    - 1) NFPA 70 - National Electric Code (NEC).
    - 2) NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
    - 3) NFPA 496 - Purged and Pressurized Enclosures for Electrical Equipment, where applicable.
    - 4) NFPA 820 - Standard for Fire Protection in Wastewater Treatment and Collection Facilities.
  - b. Underwriters Laboratories, Inc. (UL):
    - 1) UL 508 - Industrial Control Equipment.
  - c. American National Standards Institute (ANSI):
    - 1) ANSI B16.5 - Pipe Flanges and Flanged Fittings.
  - d. American Petroleum Institute (API):
    - 1) API RP551 - Process Measurement Instrumentation.
    - 2) API RP552 - Transmission Systems.
    - 3) API RP553 - Refinery Control Valves.
    - 4) API RP554 - Process Instrumentation and Control.
    - 5) API RP555 - Process Analyzers.
    - 6) API RP556 - Fired Heaters & Steam Generators.
    - 7) API RP557 - Guide to Advanced Control Systems.
  - e. American Society of Testing and Materials (ASTM):
    - 1) ASTM A269 - Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
  - f. Instrumentation, Systems, and Automation Society (ISA):
    - 1) ISA-5.1 - Instrumentation Symbols and Identification.
    - 2) ISA-5.2 - Binary Logic Diagrams for Process Operations.
    - 3) ISA-5.3 - Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic, and Computer Systems.
    - 4) ISA-5.4 - Instrument Loop Diagrams.
    - 5) ISA-5.5 - Graphic Symbols for Process Displays.
    - 6) ANSI/ISA-7.00.01 - Quality Standard for Instrument Air.
    - 7) ISA-RP - 12.4 - Pressurized Enclosures.
    - 8) ANSI/ISA-18.1 - Annunciator Sequences and Specifications.
    - 9) ISA-20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.
    - 10) ISA-TR20.00.01 - Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations Updated with 27 New Specification Forms in 2004-2005.

- 11) ANSI/ISA-50.00.01 - Compatibility of Analog Signals for Electric Industrial Process Instruments.
- 12) ISA-51.1 - Process Instrumentation Terminology.
- 13) ISA-RP60.3 - Human Engineering for Control Centers.
- 14) ISA-71.01 - Environmental Conditions for Process Measurement and Control Systems: Temperature and Humidity.
- 15) ISA-71.02 - Environmental Conditions for Process Measurement and Control Systems: Power.
- 16) ISA-71.03 - Environmental Conditions for Process Measurement and Control Systems: Mechanical Influences.
- 17) ISA-71.04 - Environmental Conditions for Process Measurement and Control Systems: Airborne Contaminants.

### 1.3 DEFINITIONS

- A. Definitions of terms and other electrical and instrumentation considerations as set forth in the:
  1. National Electrical Code.
  2. Institute of Electrical and Electronic Engineers.
  3. Instrumentation, Systems, and Automation Society.
  4. National Fire Protection Association.
  5. National Electrical Testing Association.
- B. Specific Definitions:
  1. Control Circuit: Any circuit operating at 120 volts AC or DC or less, whose principal purpose is the conveyance of information (including performing logic) and not the conveyance of energy for the operation of an electrically powered device.
  2. Panel: An instrument support system that may be either a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems. Unless otherwise specified or clearly indicated by the context, the term "panel" in these Contract Documents is interpreted as a general term, which includes flat surfaces, enclosures, cabinets and consoles.
  3. Power Circuit: Any circuit operating at 90 volts (AC or DC) or more, whose principal purpose is the conveyance of energy for the operation of an electrically powered device.
  4. Signal Circuit: Any circuit operating at less than 50 volts AC or DC, which conveys analog information or digital communications information.
  5. Digital Bus: A communication network, such as Profibus, Foundation Fieldbus, or DeviceNet, allowing instruments and devices to transmit data, control functions and diagnostic information.
  6. 2-Wire Transmitter (Loop Powered): A transmitter that derives its operating power supply from the signal transmission circuit and requires no separate power supply connections. As used in this Specification, two-wire transmitter refers to a transmitter that provides 4 to 20 mA current regulation of a signal in a series circuit with an external 24 VDC driving potential.
  7. Field Bus Communications signal or both.
  8. Powered Transmitters: A transmitter that requires a separate power source (120 VAC, 240 VAC, etc.) in order for the transmitter to develop its signal. As used in this Specification, the produced signal may either be a 4 to 20 mA current signal, a Digital Bus communications signal or both.

9. Modifications: Changing, extending, interfacing to, removing or altering an existing circuit.

C. Acronym Definitions:

1. ES: Enterprise System: Computer based communications or data sharing system utilized for non-process control functions such as E-mail, sharing files, creating documents, etc.
2. FAT: Factory Acceptance Test.
3. HOA: Hand-Off-Auto control function that is totally PLC based. In the Hand mode of control equipment is started or stopped, valves are opened or closed through operator direction under the control of the PLC software. In the Auto mode of control equipment is started or stopped, valves are opened or closed through a control algorithm within the PLC software. In the Off mode the equipment is prohibited from responding from the PLC control.
4. HMI: Human Machine Interface: PLC based operator interface device consisting of an alphanumeric display and operator input devices. The HMI is typically a flat panel type of display with either a touch screen or tactile button interface.
5. HVAC Heating, Ventilation, & Air Conditioning.
6. ICSC: Instrumentation and Control System Contractor: Subcontractor who specializes in the design, construction, fabrication, software development, installation, testing, and commissioning of industrial instrumentation and control systems.
7. IJB: Instrument Junction boxes. A panel designed with cord sets to easily remove, replace or relocate instrument signals.
8. I/O: Input / Output.
9. LCP: Local Control Panel: Operator interface panel that may contain an HMI, pilot type control devices, operator interface devices, control relays, etc. and does not contain a PLC or RIO.
10. LAN: Local Area Network: A control or communications network that is limited to the physical boundaries of the facility.
11. LOR: Local-Off-Remote control function. In the Remote mode equipment is started or stopped, valves are opened or closed through the PLC based upon the selection of the HOA. In Local control, equipment is started or stopped, valves are opened or closed based upon hardwired control circuits completely independent of the PLC with minimum interlocks and permissive conditions. In the Off mode, the equipment is prohibited from responding to any control commands.
12. OIT: Operator Interface Terminal. PC based interface device used for operator interface with the SCADA system.
13. P&ID: Process and Instrumentation Diagram.
14. PC: Personal Computer.
15. PCIS: Process Control and Instrumentation System, includes the entire instrumentation system, the entire control system, and all of the work specified in Division 17 and depicted on the Instrumentation Drawings.
16. PCM: Process Control Module: An enclosure containing any of the following devices: PLC, RIO.
17. PJB: Power Junction Box: An enclosure with terminal blocks that distribute power to multiple instruments.
18. PLC: Programmable Logic Controller.
19. RIO: Remote I/O device for the PLC consisting of remote I/O racks, or remote I/O blocks.

- 20. RTU: Remote Telemetry Unit: A controller typically consisting of a PLC, and a means for remote communications. The remote communications devices typically are radios, modems, etc.
- 21. SCADA: Supervisory Control and Data Acquisition system consists of the computer-based software system that includes the operator interface, data storage, data retrieval, archiving, alarming, historian, reports, trending, and other higher level control system software.
- 22. UPS Uninterruptible Power Supply.
- 23. VCP: Vendor Control Panel: Control panels that are furnished with particular equipment by a vendor other than the ICSC. These panels may contain PLCs, RIO, OIT, HMI, etc.
- 24. WAN: Wide Area Network: A control or communications network that extends beyond the physical boundaries of the facility.

#### **1.4 SYSTEM DESCRIPTION**

##### **A. General Requirements:**

- 1. The Work includes everything necessary for and incidental to executing and completing the general requirements for programming the control system described in the Contract Drawings and Specifications and reasonably inferable there from including but not limited to:
  - a. Procure all software.
  - b. With the electrical contractor, perform post programming tests on panels.
  - c. With the electrical contractor, oversee, document, and certify system pre-commissioning.
  - d. With the electrical contractor, conduct the Performance Tests.
  - e. Prepare Operation and Maintenance Manuals.
  - f. Conduct training classes.
  - g. Develop all requisite loop descriptions, functional narrative and instructions and record drawings associated with the programs provided under other Divisions of these Specifications.
- 2. It is the intent of these Specifications that the programmed system be complete and operable.
- 3. Furnish detailed, complete, and thorough operations and maintenance documentation, including, but not limited to: Operations Manuals, Maintenance Manuals, Training Manuals, As-Built Software Documentation, final as installed software configurations, and software disks including installed program disk.

#### **1.5 SUBMITTALS**

##### **A. General:**

- 1. Furnish Submittals that are fully developed for a given section of the work and fully indexed with a tabbed divider for every element and component.
- 2. Sequentially number the pages within the tabbed sections. Submittals and Operation and Maintenance manuals that are not fully indexed and tabbed with sequentially numbered pages, or are otherwise unacceptable, will be returned without review.
- 3. Edit all Submittals and Operation and Maintenance Manuals so that the submittal specifically applies to only the equipment furnished. Neatly cross out all extraneous text, options, models, etc. that do not apply to the equipment being furnished, so that the information remaining is only applicable to the equipment being furnished.

4. Submittal Requirements:
  - a. Submit copies of shop drawings, and product data, in accordance with the requirements of this Section:
    - 1) Show information on software to be supplied, SCADA screens, reports, menus, operation, etc.
5. Exceptions to Specifications and Drawings:
  - a. Include a list of proposed exceptions to the Specifications and Drawings along with a detailed explanation of each.
  - b. Any exceptions to the Specification and Drawings must be noted and the reason for the exception explained.
  - c. If there is insufficient explanation for the deviation, the submittal will be returned requiring Revision and Re-submittal.
  - d. Acceptance of any exception is at the sole discretion of the ENGINEER. Furnish all items (materials, features, functions, performance, etc.) that are not listed as exceptions strictly in accordance with the Specifications and Drawings.
  - e. Replace all items that do not strictly meet the requirements of the Specifications, which were not previously accepted as exceptions, even if the Submittals contained information indicating the failure to meet the requirements.
6. Submittal Organization:
  - a. First page:
    - 1) Specification Section reference.
    - 2) Name and telephone number of individual who reviewed submittal before delivery to ENGINEER.
    - 3) Name and telephone number of individual who is primarily responsible for the development of the submittal.
    - 4) Place for CONTRACTOR's review stamp and comments.
  - b. Next pages:
    - 1) Provide confirmation of Specification compliance in a tabular form that individually lists each Specification section, paragraph, and sub-paragraphs and unequivocally states compliance with said requirement or takes exception to the requirement and lists the reason for said exception and offers alternative means for compliance.
    - 2) Include a response in writing to each of the ENGINEER's comments or questions for submittal packages which are re-submitted:
  - c. In the order that the comments or questions were presented throughout the submittal.
  - d. Referenced by index section and page number on which the comment appeared.
  - e. Acceptable responses to ENGINEER's comments are either:
  - f. ENGINEER's comment or change is accepted and appropriate changes are made.
  - g. Explain why comment is not accepted or requested change is not made.
  - h. Explain how requirement will be satisfied in lieu of comment or change requested by ENGINEER.
  - i. Any re-submittal, which does not contain responses to the ENGINEER's previous comments, shall be returned for revision and re-submittal.

- j. No further review by the ENGINEER will be performed until a response for previous comments has been received.
  - k. Remaining pages:
    - 1) Actual Submittal data:
      - a) Organize Submittals in exactly the same order as the items are referenced, listed, and/or organized in the Specification section.
      - b) For Submittals that cover multiple devices used in different areas under the same Specification section, the Submittal for the individual devices must list the area where the device is intended to be used.
  - l. Specific Submittal requirements:
    - 1) Furnish the submittals required by each Section or Division 17:
      - a) Product Data.
      - b) Shop Drawings.
  - m. Furnish submittals in the following general order, each in a separate bound set:
    - 1) Product Data.
    - 2) After approval of the Product Data, submit the Project Shop Drawing submittals
    - 3) Testing, Calibration and Start-up procedures.
    - 4) Operation and Maintenance Data.
    - 5) Training Submittals.
    - 6) Record Documents.
- B. Product Data:
- 1. General:
    - a. Submitted for non-custom manufactured material listed in this and other sections and shown on shop drawings.
    - b. Furnish sufficient information to evaluate the suitability of the proposed material or equipment for the intended use, and for compliance with these Specifications.
    - c. Include:
      - 1) Catalog cuts.
      - 2) Bulletins.
      - 3) Brochures.
      - 4) Quality photocopies of applicable pages from these documents.
      - 5) Identify on the data sheets the project name, applicable specification section, and paragraph.
      - 6) Identify model number and options for the actual equipment being furnished.
    - d. Neatly cross out options that do not apply or equipment not intended to be supplied.
  - 2. Software Data Sheets and Cut Sheets:
    - a. Provide fully completed data sheets , in hardcopy, for each software package. Including the following information on the data sheet:
      - 1) License limitations, points, screens available.
      - 2) Description of software compatibilities with hardware (PLC's, ethernet communications, P.C.'s, modems, HMI's, etc.)
      - 3) Description of software capabilities, function and use.
  - 3. Software Program Submittal:
    - a. Prepare a program submittal to demonstrate how the programs address the following:
      - 1) Alarm indication and notification.

- 2) Alarm acknowledgement.
- 3) Operational sequences.
- 4) Communications.
- 5) Recording and trending – show for each recorded or tended tag.
- 6) Report generation with samples.
- 7) Maintenance information and notes storage.
- 8) Samples of each screen shot and report.

C. Operation and Maintenance Manuals:

1. Furnish the ENGINEER with a complete preliminary set of written Operation and Maintenance Manuals 2 weeks before start-up and/or testing.
2. Furnish in accordance with the following additional requirements.
3. Submit preliminary sets of these manuals to the ENGINEER for review of format and content:
  - a. ENGINEER will return 1 set with comments.
  - b. Revise and/or amended as required and submit the requisite number of copies to the ENGINEER 15 days before Pre-commissioning of the systems.
4. Incorporate changes that occur during startup and submit as part of the final manuals.
5. Provide comprehensive information on all systems and components to enable operation, service, maintenance, and repair.
6. Organize the Operation and Maintenance Manuals for each process in the following manner:
  - a. Section A-Description of operation.
  - b. Section B- Screen shots.
  - c. Section C- Report samples.
  - d. Section D- Trending/recording operations.
  - e. Section E- Software information with disks.
  - f. Section F- Operational Manual.
  - g. Section G- Spare Parts List.
7. Training Submittals:
  - a. Develop and submit for review a General Training Plan. Include complete descriptions of all planned training classes, a preliminary training schedule, a list of all proposed instructors along with resumes, examples of proposed training manuals, and a description of any special training tools to be used (simulators, self-paced modules, personal computer-based training, etc.).
  - b. The ENGINEER will review the General Training Plan. Special emphasis will be placed on review of the qualifications of the proposed instructors and the timing of the individual courses to maximize their effectiveness. If, in the opinion of the ENGINEER, the proposed instructors are not sufficiently qualified to conduct the specified training courses, or lack experience, where required, on the specific configuration of the system provide more qualified instructors.
  - c. Training Course Plan submittals:
    - 1) For each training course or other training activity, submit a detailed, complete outline and agenda for each lesson.
    - 2) Describe any student pre-requisites for the course or training activity.
    - 3) Provide an updated schedule for all sessions of the course, including dates, times, durations, and locations.
    - 4) Submit training materials.
  - d. Incorporate all submittal review comments into the course.



- e. Do not conduct training courses before review and acceptance of the Course Plan submittal for the course.

**D. Responsibilities**

1. The Programming Contractor, shall be responsible to the OWNER for the implementation of the software and programmed systems.
2. Instrumentation & Control System Contractor (ICSC) Responsibilities:
  - a. The Programming Contractor shall assume full responsibility to perform all engineering to select, furnish, install, test, calibrate, and place into operation all software for PLC's and SCADA P.C.'s.
  - b. The Programming Contractor shall be responsible for coordination with OWNER to provide a complete, integrated and functional software system.
  - c. As a minimum, the Programming Contractor shall perform the following work:
    - 1) Prepare software submittals.
    - 2) Design, develop, and implement controls, screens, reporting, recording, etc.
    - 3) Prepare the test plan, the training plan, and the spare parts submittals.
    - 4) Procure all software.
    - 5) Perform tests on PLC and SCADA software.
    - 6) Participate in system pre-commissioning.
    - 7) Participate in the performance tests.
    - 8) Prepare Technical Manuals.
    - 9) Conduct training classes.
3. Owner's Responsibilities:
  - a. Assist the Programming Contractor in coordinating and integrating the system controls.
  - b. The Programming Contractor shall not be responsible for providing or testing any hardware.
4. The Programming Contractor and the Instrumentation & Control System Contractor will be one and the same for this contract.

**E. Programmer Qualifications:**

1. The Qualification requirements specified in these paragraphs apply to the portions of the Process Control and Instrumentation System Work to be provided by the Programming Contractor.
2. The Programming Contractor shall meet the following minimum qualifications:
  - a. The Programming Contractor shall have completed at least five (5) successfully completed projects for a pumping system of similar scope and complexity in which the Programming Contractor used components the same as those intended for use on this project, performed system programming, documentation, including software configuration and documentation, field testing, calibration and start-up, operator instruction and maintenance training.
  - b. The Programming Contractor company shall be actively involved in the instrumentation, PLC based control systems, and SCADA systems business for a minimum of ten years and has adequate facilities, organization structure, manpower and technical and managerial expertise to properly perform the WORK under and in conformance with these Specifications.

**1.6 SEQUENCING**

**A. General:**

1. General scheduling requirements are specified in Section 01313.
2. Refer to Section 01010 for summary of work.
3. Testing requirements are specified in Division 27.

4. Work restrictions and other scheduling requirements are specified in Section 01140.
- B. Pre-submittal Conferences:
  1. Before producing any submittals, schedule a pre-submittal Conference for the purposes of reviewing the entire project, equipment, control philosophy, schedules, and submittal requirements.
- C. Training:
  1. Complete all training before the pre-commissioning phase of the project may start.
  2. Schedule the training sessions a minimum of 15 days prior to the start date of the courses.
  3. Submit training manuals to the ENGINEER a minimum of 10 days before starting the training session.
  4. Within 10 days after the completion of each session, submit the following:
    - a. A list of all OWNER personnel that attended the session.
    - b. A copy of the training materials utilized during the lesson with all notes, diagrams, and comments.
- D. Performance Testing:
  1. Complete Pre-commissioning test a minimum of 5 days before the Performance Test.
  2. Conduct a 90-day Performance Test.

### **1.7 WARRANTY**

- A. Warrant the Software and Programming in accordance with the General Conditions:
  1. Provide additional warranty as specified in the individual Division 17 Specifications.

### **1.8 SYSTEM STARTUP**

- A. Replace or modify software, and materials that do not achieve design requirements after installation in order to attain compliance with the design requirements:
  1. Following replacement or modification, retest the system and perform additional testing to place the complete system in satisfactory operation and obtain compliance acceptance from the ENGINEER.

### **1.9 MAINTENANCE**

- A. Before Substantial Completion, perform all maintenance activities required by any sections of the Specifications including any calibrations, final adjustments, component replacements or other routine service required before placing equipment or systems in service.

## **PART 2 -**

### **2.1 PROGRAMMABLE LOGIC CONTROLLER SYSTEM**

- A. Acceptable Manufacturers. Include compatible I/O modules and communication modules, and telemetry solutions as required by the design. Regardless of this list, the PLC shall be coordinated with the OWNER before proceeding to ensure compatibility with any existing SCADA / PLC systems and OWNER requirements and standards.

## 1. Schneider Modicon

### 2.2 PLC ENCLOSURE AND ACCESSORIES

- A. PLC Enclosure and Accessories: The PLC enclosure shall house the power supplies, PLC processor, analog input and output modules, discrete input and output modules, communication module, operator interface terminal (OIT), UPS, thermostatically controlled vent fan and louvers, heater with thermostat, light with integral door switch, relays, terminal blocks, and ancillary components. In addition, provide 25% spare back panel space and space for additional cards as indicated. The PLC shall be equipped with the following accessories, at a minimum:
1. Enclosure: The PLC shall be housed in a NEMA type12 enclosure with a lockable 3-point latch, and an interior swing out panel. The enclosure, swing out panel, vent fan, heater, and light shall be manufactured by Hoffman, or equal.
  2. Redundant Power Supplies: Power supply hardware shall include a PLC power supply and redundant 24VDC power supplies as required for Inputs and Outputs (I/O). The redundant power supplies shall be 100 watt, minimum.
  3. Fusing: Individual I/O loops shall be individually fused. Fuse holders shall be indicating type.
  4. I/O Terminal Blocks: Field wiring DIN rail type terminal blocks. 25% spare terminal blocks shall be provided. Discrete and analog I/O terminals shall be segregated by I/O type.
  5. Plastic Snap-On Cover Wire Management Systems: These shall be sized to accommodate all wiring with 25% spare capacity.
  6. UPS System: A panel mounted UPS shall be included in each PLC cabinet. The UPS's shall be sized to provide at least 30 minutes of run time for the PLC and all system I/O. UPS systems shall be as specified elsewhere.
  7. Transient Voltage Surge Suppression (TVSS): The TVSS system shall protect all power wiring within the PLC enclosure. The TVSS shall be a branch panel model as specified in Section 26 35 53.
  8. Work Light and Outlet: A work light utilizing a 32 watt self ballasted compact fluorescent lamp or equal with an integral door operated switch shall be mounted within the enclosure. Enclosures over 4' wide shall include a light in each 4' section. A 20 amp, 120 volt duplex grounded power outlet shall be mounted within the PLC enclosure.
  9. Ground Terminals: A screw type bonding terminal strip to which all ground bonding shall take place for all signal reference, TVSS, safety bonding etc. This grounding terminal shall accept a #6 copper ground bonding conductor. 25% spare terminals shall be provided.
  10. Enclosure Labeling: The enclosure shall carry a phonetic label indicating the enclosure name, label all pilot devices on the swing out panel, and label all I/O termination modules, relays, power supplies, etc. Internal wiring shall be labeled at each terminal and each terminal shall be labeled, all labeling names and/or numbers shall be reflected on the panel fabrication drawings.

11. Separate Power Warning Signs: The enclosure shall receive power from external sources and shall be labeled with the source of where the external power is derived. Each circuit providing power to the cabinet shall be indicated.
- B. Operator Interface Terminal (OIT/HMI): An OIT/HMI shall be mounted in the PLC enclosure swing-out panel. The OIT shall be 7" touchscreen or nearest available size compatible with the PLC equipment, with keypad, 24VDC power, color graphics, and Ethernet communications operating from the terminal server with terminal services client software.
1. Provide OIT programming software to the OWNER, registered in OWNER's name.
  2. Provide a programming cable for connection to a Personal Computer for the transfer of files.

## **2.3 INPUT/OUTPUT MODULES**

- A. Analog transmitters and receivers have 4 to 20 mA signals. Discrete (on/off) inputs (DI) originate from dry contacts. For discrete outputs (DO), provide interposing relays with dry contacts. Refer to the PLC Input / Output Point List, Appendix A, for required inputs and outputs.
- B. The discrete input modules shall be 24 VDC.
- C. The discrete output modules shall be isolated relay contacts suitable for operating interposing relays. Each discrete output module shall include fuses and fuse blown indicators.
- D. The analog input (AI) modules shall be suitable for accepting 4 to 20 mA from 2, 3, or 4 wire transmitters. The input power shall be from an internal or external 24-volt dc power supply. The analog to digital converter shall have a 10-bit minimum resolution with an overall accuracy of  $\pm .5\%$  at 60°C.
- E. The analog output (AO) modules shall be 4 to 20 mA signals suitable for driving into a 0 to 600 ohm load without load adjustments. The digital to analog converter shall have a 10 bit minimum resolution with an overall accuracy of  $\pm 2\%$  to 60°C. The output power shall be from an internal or external, 24 volt dc power supply provided by the SUPPLIER. If the PLC processor fails, the analog outputs shall retain their present value.
- F. Discrete PLC I/O modules shall have individual LED status lights for each I/O point. All discrete and analog modules shall have terminal blocks for termination of the I/O wires. Individual I/O points shall be capable of withstanding low energy common mode transients to 1,500 volts.

## **2.4 PLC START-UP**

- A. Each PLC shall have start-up software that causes automatic commencement of operation without human intervention, including start-up of all connected I/O functions. A restart program based on detection of power failure shall be included in the software. Upon restoration of power, the program shall restart all equipment and restore all loads to the state at time of power failure, or to the state as commanded by time programs or other overriding programs. The restart program shall include start time delays between successive commands to prevent demand surges or overload trips. The start-up software shall initiate operation of self-test diagnostic routines. If the data base and application software are no longer resident or if the

clock cannot be read, the PLC shall not restart and systems shall remain in the failure mode indicated until the necessary repairs are made. If the data base and application programs are resident, the PLC shall resume operation after an adjustable time delay of from 0 to 600 seconds. The start-up sequence for each device shall include a unique time delay setting when system operation is initiated.

- B. Programming software for the PLC shall be provided by the contractor. The programming of the PLC shall be performed by the contractor. All loop testing and debugging shall be performed by the Contractor.

## **PART 3 -**

### **3.1 DEMONSTRATION AND TRAINING**

#### **A. Training:**

1. Provide Orientation and training on the process control and instrumentation scope to fulfill the needs as outlined by the owner/operators, not expected to exceed the following:
2. General:
  - a. Provide system maintenance and operator training courses for all the instrumentation and control systems furnished.
  - b. Conduct all training at the Project Site unless another location is approved by the ENGINEER and OWNER.
    - 1) Include instruction on the use of all maintenance equipment and special tools provided under the contract.
  - c. Tailor training classes to the specific needs of the class participants:
    - 1) The specific categories and number of personnel in each category are identified below.
    - 2) Furnish training courses that are a combination of classroom and hands-on training:
    - 3) Present the minimum number of sessions, specified in Table 1, for each course in order to satisfy class size restrictions and limitations scheduling OWNER staff.
    - 4) Furnish additional sessions if required to accommodate the total number of personnel identified for each course.
    - 5) Schedule individual training classes with the OWNER at least 3 weeks before the start of the class.
    - 6) Schedule all training classes Monday - Friday between 7:30 AM and 3:30 PM.
    - 7) Each individual daily training session, travel time excluded:
      - a) Minimum duration of 4 hours.
      - b) Maximum duration of 7 hours.
      - c) Breaks scheduled at least every 90 minutes and 1 hour for lunch.
    - 8) Complete training for maintenance personnel 90-days before Performance Testing.
    - 9) Complete operator training classes before startup of the SCADA system, or any part of it:
    - 10) Refer to Paragraph 1.09 of this Section.
    - 11) Schedule follow-up training classes after SCADA startup on a schedule determined by the OWNER.

- a) Furnish highly qualified training instructors for technical training with demonstrated expertise in not only control system functionality but also professional training techniques:
  - b) Provide completion reports in accordance with Paragraph 1.09 of this Section.
- 3. Training Manuals and Materials:
  - a. Furnish training manuals and other materials for training courses.
  - b. Manuals are to be professionally written to present the course material in a format that is easy to comprehend.
  - c. The manuals are to serve as teaching aids during presentation of the training classes.
  - d. Manuals are to serve as reference material after the training has been completed.

Table 1			
Course Title	Minimum Course Length (days per session)	Personnel (Estimated Number of Students)	Minimum Number of Sessions
SCADA, HMI, PLC Software	1	5	1

- 4. Training Course Requirements:
  - a. Software Training:
    - 1) Furnish training on software and on related systems, including operation alarms, control, recording, reporting, etc.
    - 2) Furnish training on features, operation, troubleshooting, and maintenance.
  - b. HMI Training:
    - 1) Provide the following:
      - a) Overview of firmware, including starting, stopping, and PLC interface.
      - b) Troubleshooting.
  - c. Follow-up Training:
    - 1) Provide on-site follow-up training class beginning after startup of the SCADA system. The intent for these classes is to provide the OWNER's personnel the opportunity for a review and "refresher" of the training topics and material after they have had some experience using the system.
    - 2) Mutually schedule and develop the content of these classes with the OWNER no later than 1 month before the beginning of the first session:
      - a) Schedule at the OWNER's discretion on non-consecutive days spaced out over the start-up and warranty period.

**END OF SECTION**

**SECTION 40 12 50**  
**PRESSURE TRANSMITTER**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 40 10 00 – Process Control and Instrumentation System, General
- B. Section 40 20 00 – Instruments, General

**PART 2 - PRODUCTS**

**2.1 PRESSURE TRANSMITTERS**

**A. Gauge Pressure Transmitters**

1. Acceptable manufactures are:
  - a. Emerson Rosemount 3051 Series
2. Power supply shall be 24VDC, powered from PLC panel power supply. Process connection shall be 1/2-inch female NPT flange adapter. Signal output shall be 4 to 20 mA.
3. Pressure transmitter shall be capacitance or resonant-wire type. Unless otherwise specified, wetted parts shall be ASTM A276, type 316 stainless steel. Span shall be adjustable over a 6:1 or greater range. Over range capacity without affecting calibration shall be not less than 200 percent of maximum specified range. Volumetric displacement shall not exceed 0.01 cubic inch over the specified span. Fill fluid unless otherwise specified shall be silicone oil. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be 0.25 percent of span or better for spans greater than 5 inches water column and 0.5 percent of span or better for spans less than or equal to 5 inches water column.

4. Transmitter shall be provided with the following adjustable range:

Adjustable range of transmitter, water column	Span specified in the instrument schedule, water column
0.5 to 6 inches	0.5 to 5.5 inches
5 to 30 inches	5.5 to 27.5 inches
25 to 150 inches	27.5 to 137.5 inches
125 to 750 inches	137.5 to 750 inches

Higher ranges and spans shall be provided as specified in the instrument schedule. Transmitter for spans less than or equal to 25 psig shall be provided with one 1/2-inch flanged process connection and two 1/4-inch drain/vent ports, one plugged and one provided with bleed valve. Transmitter shall be provided with an evacuated sealed chamber and reference diaphragm shall be provided with a weatherproof, bug proof atmospheric vent. Transmitters for spans greater than 25 psig shall be similar except designed for gage pressure service, and overpressure rating shall be greater than the lesser of 2000 psig and 150 percent of maximum range.

## **PART 3 - EXECUTION**

### **3.1 REQUIREMENTS**

A. Refer to Section 40 20 00.

**END OF SECTION**



**SECTION 40 20 00**  
**INSTRUMENTS GENERAL**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall furnish, install, test, and place in operation process instrumentation (flow elements, level transmitters, etc.) as scheduled herein together with all signal converters, transmitters, isolators, amplifiers, etc. to interface with all instrumentation, panels, controls, and process equipment control panels with the process control system as shown on the Drawings and as specified. Mounting of associated transmitters, indicators, power supplies, brackets, and appurtenances shall be provided as specified herein and shown on the Drawings.
- B. It is the intent of this Specification and the Contract Documents that all process taps, isolation valves, nipples, penetrations, embedded instrumentation supports, conduit, wiring, terminations, and the installation of the process instrumentation on process lines shall be provided under this Contract.
- C. Taps and connections for primary process sensors shall be sized to suit each individual installation and the requirements of the instrument served. It is the Contractor's responsibility to ensure that the location, supports, orientation, and dimensions of the connections and taps for instrumentation as such as to provide the proper bracing, the required accuracy of measurement, protection of the sensor from accidental damage, and accessibility for maintenance while the plant is in operation. Isolation valves shall be provided at all process taps.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 40 10 00 – Process Control and Instrumentation Systems
- B. Division 26.

**1.3 REFERENCES**

- A. This section contains references to the following documents. They are a part of this section as specified and modified. Where a referenced document contains references to other standards, those documents are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

Reference	Title
API RP550	Manual on Installation of Refinery Instruments and Control Systems, Part I – Sections 1 Through 13
ISA S20	Specification Forms for Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology

#### 1.4 GENERAL INFORMATION AND DESCRIPTION

- A. These Specifications are intended to give a general description of what is required, but do not cover all details which will vary in accordance with the requirements of the equipment

furnished. They are, however, intended to cover the furnishing, the shop testing, the delivery, and complete installation and field testing of all instruments and appurtenances whether specifically mentioned in the Specification or not.

- B. The instruments shall be furnished and installed with all necessary accessory equipment and auxiliaries whether specifically mentioned in these Specifications or not. The installations shall incorporate the highest standards for the type of service shown on the Drawings including loop testing of the entire installation and instruction of operating personnel in the care, operation, calibration, and maintenance of all instrumentation.
- C. All instrumentation shall be of first class workmanship and shall be entirely designed and suitable for the intended services. All materials used in fabricating the equipment shall be new and undamaged.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All instrumentation supplied shall be the manufacturer's latest design. Unless otherwise specified, all instruments shall be solid state, electronic, using enclosures to suit specified environmental conditions. Microprocessor-based equipment shall be supplied unless otherwise specified. All instruments shall be provided with mounting hardware and floor stands, wall brackets, or instrument racks as shown on the Drawings or as required.
- B. Equipment installed in hazardous areas shall meet Class, Group, and Division as shown on the Drawings, to comply with the National Electric Code.
- C. All instruments shall return to accurate measurement without manual resetting upon restoration of power after a power failure.
- D. Unless otherwise shown or specified, local indicators shall be provided for all instruments. Where instruments are located in inaccessible locations, local indicators shall be provided and shall be mounted as specified in paragraph 3.1.B. All indicator readouts shall be linear in process units. Readouts of 0-100% shall not be acceptable, except for speed and valve position. Floating outputs shall be provided for all transmitters.
- E. Unless otherwise specified, field instrument and power supply enclosures shall be 316 stainless steel, fiberglass, or PVC coated copper free cast aluminum NEMA 4X construction.
- F. Where separate elements and transmitters are required, they shall be fully matched, and unless otherwise noted, installed adjacent to the sensor. Special cables or equipment shall be supplied by the associated equipment manufacturer.
- G. Electronic equipment shall utilize printed circuitry and shall be coated (tropicalized) to prevent contamination by dust, moisture, and fungus. Solid-state components shall be conservatively rated for long term performance and dependability over ambient atmospheric fluctuations. Ambient conditions shall be -15 to 50 degrees C and 10 to 100 percent relative humidity, unless otherwise specified. Field mounted equipment and system components shall be designed for installation in dusty, humid, and corrosive service conditions.
- H. All devices furnished hereunder shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All

equipment provided, where applicable, shall be of modular construction and shall be capable of field expansion.

- I. All non-loop powered instruments and equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 V, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided. Where equipment requires voltage reduction, constant voltage transformers shall be supplied.
- J. All analog transmitter and controller outputs shall be isolated, 4-20 milliamps into a load of 0-750 ohms, unless specifically noted otherwise. All switches shall have double-pole, double-throw contacts rated at a minimum of 600 VA, unless specified otherwise.
- K. Materials and equipment used shall be U.L. approved wherever such approved equipment and materials is available.

## 2.2 ACCESSORIES

- A. Isolation Valves – Valves shall be full port ball valves with ASTM A276, Type 316 stainless steel trim and body and with Teflon seats and packing. Valves shall be Parker CPI, Whitey, Hoke, or equal.
- B. Gage Valves – Gage valves shall be machined from ASTM A276 bar stock and shall be provided with 1/2-inch NPT connections and integral bleed valve. Valves shall be Anderson, Greenwood & Company M9530, Hoke 6801L8Y, or equal.
- C. Root Valves – Root valves shall be ASTM A276, Type 316 stainless steel bar stock with 1/2-inch NPT male process connection and three 1/2-inch NPT female instrument connections. One instrument connection shall be provided with an ASTM A276, Type 316 stainless steel bleed valve. ASTM A276, Type 316 stainless steel plugs shall be provided for unused ports. Lagging type units shall be provided for insulated vessels and pipes. Root valves shall be Anderson, Greenwood & Company M5 AVS-44, Hoke 6802L8Y, or equal.
- D. Manifolds – Manifolds shall be three-valve bar-stock type. Manifold body shall be machined from 316 stainless steel bar stock. Valves shall be globe configuration with 316 stainless steel ball seats and Teflon stem packing. Manifolds shall be designed for direct mounting to differential pressure transmitters in place of the flanges normally furnished. Fabricated manifolds or manifolds employing needle or soft seat valves are not acceptable. Purge taps, 1/8-inch NPT shall be furnished on manifolds where water purge is specified. Manifolds shall be Anderson Greenwood M4TVS, Hoke 8123F8Y, or equal.
- E. Tubing – Instrument tubing between the process connection and instruments shall be 1/2-inch x 0.065-inch seamless annealed ASTM A269, Type 316 stainless steel. Tubing fittings shall be Type 316 stainless steel. Fittings shall be of the swage ferrule design and shall have components (nut, body and ferrule system) interchangeable with those of at least one other manufacturer. Flare and ball sleeve compression type are not acceptable. Fittings shall be Parker CPI, Crawford Swagelok, Hoke Gyrolok, or equal.
- F. Chemical Seals
  - 1. Diaphragm – Seal shall be the diaphragm type with flushing connection, Type 316 stainless steel body and Type 316L diaphragm unless otherwise specified. Seal shall be Mansfield and Green Type SG, Ashcroft Type 101, or equal.
  - 2. Annular Ring – Seal shall be the in-line full stream captive sensing liquid type. Metallic wetted parts shall be Type 316 stainless steel. Flexible cylinder shall be Buna-N unless otherwise specified. Seals shall be rated 200 psig with not more than 5-inch

WC hysteresis. Seals shall be Ronningen-Petter Iso-Ring, Red Valve series 40, or equal.

3. Fill Fluid – Chemical seals and associated instruments shall be factory filled as follows: Instrument side of seal, capillary tubing, and instrument shall be evacuated to an absolute pressure of 1.0 Torr or less; filled; and sealed. Unless otherwise specified, fill fluid shall be silicone oil, Dow Corning DC200, Syltherm 800, or equal.

G. Bushings and Thermowells – Bushings or thermowells shall comply with SAMA PMC17-10. Temperature taps shall be 1/2-inch NPT, and lagging extensions shall be provided on insulated vessels or pipes. Thermowells and bushings shall be machined from Type 316 stainless steel bar stock unless otherwise specified.

#### H. Purge Assemblies

1. Air – Air purge assembly shall consist of a constant-differential relay, needle valve, check valve and 0.2 to 2.0 scfh rotameter. Assembly shall be Moore Products 62VA, Fischer & Porter 10A3137N-3BR2110, or equal.
2. Water – Water purge assembly shall consist of a strainer, constant-differential regulator, needle valve, check valve, and 20 to 200 cc/m rotameter. Assembly shall be Moore Products 63BD4A, Fischer & Porter 10A3137N-53BR2110, or equal. Strainer shall be 155 micron wye-type, ASCO 8600A2, Crane, or equal.

### 2.3 POWERED INSTRUMENTS GENERAL REQUIREMENTS

- A. Powered instruments are those instruments which require power (120 VAC or 24 VDC loop power) to operate. Each instrument includes an element or analyzer and a transmitter/controller.
- B. Transmitters shall be 4 to 20 milliampere output two-wire type with operating power derived from the transmission circuit. Transmitter shall support an external load of 0 to 600 ohms or greater without requiring trimming resistors with a transmission circuit power supply of 24 volts. Transmitter output shall be galvanically isolated from the process and the transmitter case. Time constant of transmitters used for flow or pressure measurement, including level transmitters used for flow measurement, shall be adjustable from 0.5 to 5.0 seconds. Transmitter output shall increase with increasing measurement except where "reverse action" is specified in the instrument schedule.
- C. Electrical parts of transmitter and/or primary element mechanisms shall, as a minimum be housed in enclosures meeting NEMA 250, Type 4 requirements. Where electrical mechanisms are located outdoors or in areas specified as corrosive, enclosures shall meet NEMA 250, Type 4X requirements.
- D. Transmitters located outdoors shall be provided with surge protectors: Rosemount Model 470A, Taylor 1020FP, or equal.
- E. Where two-wire transmitter is located in an area classified as hazardous, it shall be made safe by means of an intrinsic safety barrier. Intrinsic safety barriers for two-wire transmitters shall be of the active, isolating, loop powered type. Barrier shall be Measurement Technology LTD. type MT3042, Stahl 9005/01-252/100/00, or equal.
- F. Where four-wire transmitters are permitted, they shall be provided with a loop powered signal current isolator connected in the output signal circuit. Isolator shall provide galvanic isolation of milliampere transmission signals from transmitters with inadequately isolated output circuits. Isolator shall be housed in a NEMA 250, type 4/7 conduit body and shall derive its operating power from the signal input circuit. Input and output signals shall be 4 to 20 milli

amperes, and error shall not exceed 0.1 percent of span. Input resistance shall not exceed 550 ohms with an output load of 250 ohms. Isolator shall be Moore Industries SCX/4-20MA/4-20/MA/6.5DC/-RF(EX).

## 2.4 PROCESS SWITCHES GENERAL REQUIREMENTS

- A. Contact outputs used for alarm actuation shall be ordinarily closed and shall open to initiate the alarm. Contact outputs used to control equipment shall be ordinarily open and shall close to start the equipment. Contacts monitored by solid state equipment such as programmable controllers or annunciators shall be hermetically sealed and designed for switching currents from 20 to 100 mA at 24 volts DC. Contacts monitored by electromagnetic devices such as mechanical relays shall be rated NEMA ICS 2, designation B300. Double barriers shall be provided between switch elements and process fluids such that failure of one barrier will not permit process fluids into electrical enclosures. Switch electrical enclosures shall be rated NEMA 250, type 4 minimum. Contacts in Class 1, Division 1 areas and monitored by solid-state circuits shall be made safe by suitable intrinsic safety barriers as specified in Section 26 09 13 .

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General – Equipment shall be located so that it is accessible for operation and maintenance. Electrical work shall be performed in compliance with all applicable local codes and practices. Where these specifications and the Drawings do not delineate precise installation procedures, API RP550 shall be used as a guide to installation procedures.
- B. Equipment Mounting and Support
1. Field equipment shall be wall mounted or mounted on two-inch diameter aluminum pipe stands welded to a 10-inch square, ½-inch thick aluminum steel baseplate. Instruments attached directly to concrete shall be spaced out from the mounting surface not less than ½-inch by use of phenolic spacers. Expansion shields in walls shall be used for securing equipment or wall supports to concrete surfaces. Unless otherwise noted, field instruments shall be mounted between 48 and 60 inches above the floor or work platform.
  2. Embedded pipe supports and sleeves shall be schedule 40, 304 stainless steel pipe, with stainless steel blind flange for equipment mounting as shown on the Drawings.
  3. Materials for miscellaneous mounting brackets and supports shall be 304 stainless steel.
  4. Pipe stands, mounting brackets, and supports shall comply with the requirements of Division 5.
  5. Where transmitters are supported from process piping, leveling saddles shall be provided. Transmitters shall be oriented such that output indicators are readily visible.
- C. Control and Signal Wiring – Electrical, control, and signal wiring connections to transmitters and elements mounted on process piping or equipment shall be made through liquid-tight flexible conduit. Conduit seals shall be provided where conduits enter all field instrument enclosures and all cabinetry housing electrical or electronic equipment.

### 3.2 CLEANING AND ADJUSTMENT

#### A. General

1. The Contractor shall comply with the requirements of Division 1 and all instrumentation and control system tests, inspection, and calibration requirements for all instrumentation and controls provided under this Contract and specified herein. The Engineer, or his designated representative(s), reserve the right to witness any test, inspection, calibration, or start-up activity. Acceptance by the Engineer of any plan, report, or documentation relating to any testing or commissioning activity specified herein shall not relieve the Contractor of his responsibility for meeting all specified requirements.
2. The Contractor shall provide the services of factory trained technicians, tools, and equipment to field calibrate, test, inspect, and adjust each instrument to its specified performance requirement in accordance with manufacturer's specifications and instructions. Any instrument which fails to meet any contract requirements, or any published manufacturer performance specification for functional and operational parameters, shall be repaired or replaced, at the discretion of the Engineer, at no cost to the Owner. The Contractor shall bear all costs and provided all personnel, equipment, and materials necessary to implement all installation tests and inspection activities for equipment specified herein.

#### B. Field Instrument Calibration Requirements

1. Each instrument shall be calibrated at 0, 25, 50, 75, and 100 percent of span using test instruments to simulate inputs and read outputs. Test instruments shall be rated to an accuracy of at least five times greater than the specified accuracy of the instrument being calibrated. Where applicable, such test instruments shall have accuracies as set forth by the National Bureau of Standards.
2. The Contractor shall provide a written calibration sheet to the Engineer for each instrument, certifying that it has been calibrated to its published specified accuracy. This sheet shall include but not be limited to date, instrument tag numbers, calibration data for the various procedures, name of person performing the calibration, listing of published specified accuracy, permissible tolerance at each point of calibration, calibration reading as finally adjusted within tolerance, defect noted, corrective action required, and corrections made.
3. If doubt exists as to the correct method for calibrating or checking calibration of an instrument, the manufacturer's recommendations shall be used as an acceptable standard, subject to approval of the Engineer.
4. Upon completion of calibration, devices calibrated hereunder shall not be subjected to sudden movements, accelerations, or shocks, and shall be installed in permanent protected positions not subject to moisture, dirt, and excessive temperature variations. Caution shall be exercised to prevent such devices being subjected to overvoltages, incorrect voltages, overpressures, or incorrect air. Damaged equipment shall be replaced and recalibrated at no cost to the Owner.
5. Upon completion of instrumentation installation, the Contractor shall perform a loop check. The Contractor shall submit final loop test results with all instruments listed in the loop. Loop test results shall be signed by all representatives involved for each loop test.

**END OF SECTION**



**SECTION 40 27 60**  
**PRESSURE SWITCHES AND SEALS**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure switches and seals with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

**1.2 MANUFACTURERS**

- A. Section 40 10 00 – Process Control and information Systems
- B. Section 40 20 00 – Instruments, General

**PART 2 - PRODUCTS**

**2.1 Pressure Instrumentation**

**A. Seals**

- 1. All pressure switches and/or transmitters shall be provided with seals.
- 2. Pressure switches, gages, and/or transmitters and seals shall be assembled and oil filled at the factory prior to shipment. Filling fluid shall be compatible with piping contents and temperature.
- 3. Pressure switches and/or transducers attached to systems involving chemical solutions, corrosive fluids, or other liquids containing one percent or more of solids, shall be equipped with diaphragm or annular seals whether shown or not on the drawings, or equal protective pressure sensing devices, as follows:

**a) Clear process water applications:**

- 1. Type 316 stainless steel for pressures over 15 psi.
- 2. Elastomer for pressures of 15 psi and below.
- 3. Type 316 stainless steel nuts and bolts, fill connection and valved flush port size of ¼-inch NPT, capable of disassembly without loss of filler fluid.
- 4. As manufactured by:
  - a) Ashcroft Type 101
  - b) Or prior approved equal.

**b) For chemical solutions, sludge, etc., where breakage does not create major shutdown:**

- 1. Seals with PVC body for removable mounting rated at 200 psi.
- 2. Type 316 stainless steel bolts and nuts

3. ½-inch inlet
4. ¼-inch outlet
5. Liquid-filled with Teflon diaphragm for pressure.
6. Elastomer diaphragm for vacuum service.

c) For sludge, liquids containing solids, pulsating flow:

1. Pressure instrument protectors shall be of the isolation ring type seal with integral instrument removal device.
2. Construction
  - a. Unit consists of a body, 360 degree flexible elastomeric cylinder with positive O-ring type sealing arrangement, captive fill fluid and two assembly flanges.
  - b. Includes integral instrument removal device to remove instrumentation without interrupting process flow. The isolation ring I.D. shall match the pipeline I.D. The isolation ring O.D. shall not exceed the I.D. of the piping flange bolt circle. Units are designed to fit 135#, 150# and 300# ANSI piping flanges.

3. Materials

- a) Body is 316 Stainless Steel unless otherwise required. Two assembly flanges are 316 S.S. Flexible elastomeric cylinder is Silicone. Captive sensing liquid is glycerin, Silicone or Halocarbon as required for the piped fluid.

4. As manufactured by:

- a) Ashcroft Type 80, 81.
- b) Prior Approved Equal.

2.2 Pressure Switches High

a) General:

- 1) Enclosure NEMA 4X
- 2) Manual Reset trip on increasing pressure
- 3) DPDT
- 4) Actuator Seal: Teflon
- 5) Each pressure switch shall have visible scale and contact operation.

- b) Pressure switches shall have a contact rating of 10 amperes at 125 VAC.

- c) Pressure switches shall be snap-action switches and shall be in general-purpose enclosures at indoor installations, or weatherproof enclosures at outdoor installations.
- d) Diaphragm seals shall be provided and included at the locations shown.
- e) Automatic reset
- g) Standard Ranges:
  - 1) 10" H2O, Proof psi 20, Burst psi 35
  - 2) 30" H2O, Proof psi 20, Burst psi 35
  - 3) 60" H2O, Proof psi 20, Burst psi 35
  - 4) 100" H2O, Proof psi 20, Burst psi 35
  - 5) 150" H2O, Proof psi 20, Burst psi 35
  - 6) 15" H2O, Proof psi 500, Burst psi 1000
  - 7) 30" H2O, Proof psi 500, Burst psi 1500
  - 8) 60" H2O, Proof psi 500, Burst psi 1500
  - 9) 100" H2O, Proof psi 1000, Burst psi 3000
  - 10) 200" H2O, Proof psi 1000, Burst psi 3000
  - 11) 400" H2O, Proof psi 2400, Burst psi 3000
  - 12) 600" H2O, Proof psi 2400, Burst psi 3000
- h) As manufactured by:
  - 13) Mercooid.
  - 14) Or approved equal.

## 2.3 Pressure Switches Low

- a) Device identifications: See Section 40 20 00
- b) General:
  - 1) Enclosure NEMA 4X
  - 2) Manual Reset trip on increasing pressure
  - 3) DPDT
  - 4) Actuator Seal: Teflon
  - 5) Each pressure switch shall have visible scale and contact operation.
- c) Pressure switches shall have a contact rating of 10 amperes at 125 VAC.
- d) Pressure switches shall be snap-action switches and shall be in general-purpose enclosures at indoor installations, or weatherproof enclosures at outdoor installations.

- e) Diaphragm seals shall be provided and included at the locations shown.
  - f) Automatic reset.
  - i) As manufactured by:
    - 1) Mercoid.
    - 2) Or approved equal.
- B. The CONTRACTOR shall deliver to the OWNER all required spare parts. The spare parts shall not be used as replacement parts during system start-up or the guarantee period.

### **PART 3 - EXECUTION**

#### **3.1 REQUIREMENTS**

- A. See Section 40 20 00.

**END OF SECTION**

**SECTION 40 91 20**  
**PRESSURE GAUGES**

**PART 1 – GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure gauges and seals with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

**1.2 RELATED SPECIFICATION SECTIONS**

- A. Section 40 10 00 – Process Control and information Systems
- B. Section 40 20 00 – Instruments, General
- C. Section 40 27 60 – Pressure Switches and Seals

**1.3 SUBMITTALS**

- A. Furnish complete submittals in accordance with Section 01 30 00.
- B. Product Data
  - 1. Complete manufacturer's brochures; identify instrument construction, accuracy, ranges, materials and options.
  - 2. Complete instrument data sheets, including catalog number and source for determining catalog number for all gauges and seals.

**PART 2 - PRODUCTS**

**2.1 PRESSURE INSTRUMENTATION**

- A. Seals
  - 1. All pressure gauges shall be provided with seals. See Section 40 91 19.26.
  - 2. Pressure gauges and seals shall be assembled and oil filled at the factory prior to shipment. Filling fluid shall be compatible with piping contents and temperature.

**2.2 PRESSURE GAUGES MANUFACTURED UNITS**

- A. Pressure, Vacuum, Compound Gauges.
  - 1. General
    - a. Furnish and install pressure and vacuum gauges as specified; complete, including all fittings, snubbers, connections, gaskets, supports and accessories in the locations shown or specified, in accordance with the Contract Documents.
    - b. Pressure gauges shall be provided whether or not shown on the plans:
      - 1) On suction and discharge connection to all pumps.
      - 2) On discharge connection from blowers and compressors.

- 3) On each side of pressure reducing valves.
  - 4) In other locations as shown on the P&IDs and/or mechanical plans.
  - c. Vacuum gauges shall be provided whether or not shown on the plans:
    - 1) On all supply side educator type chemical feeders.
    - 2) In other locations as shown on the P&IDs and/or mechanical plans.
  - d. Sleeve pressure gauges
    - 1) Shall be provided where shown on the plans.
    - 2) Pressure shall be sensed by a flexible sleeve contained in a flanged cast iron or steel spool or wafer body, and transmitted to the gauge through a captive fluid.
    - 3) Sleeve shall be of BUNA A and fabricated so as to isolate the body from the process liquid.
    - 4) Gauges shall be calibrated to read in applicable units.
    - 5) Accuracy of  $\pm 1\%$  to 150% of the working pressure of the system to which they are connected.
2. Construction
- a. Gauges shall be industrial quality type with Type 316 stainless steel movement.
  - b. Phenolic case.
  - c. Liquid filled.
  - d. Unless otherwise shown or specified, gauges shall have:
    - 1) A 4 ½ inch dial.
    - 2) ½ inch threaded connection.
    - 3) Type pulsation dampener adapter.
      - a) Pulsation Dampener as manufactured by:
        - b) Cajon Co.
        - c) Weksler Instruments, Corp.
        - d) Ashcroft.
        - e) No equals.
      - 4) A block and bleed valve – ½ inch national pipe thread process connection and bleed/calibrate valve between block valve and outlet port.
  - e. Gauges shall be calibrated to read in applicable engineering units.
  - f. Accuracy of  $\pm 0.5\%$  to 150% of the working pressure or vacuum of the pipe or vessel to which they are connected.

- g. All gauges shall be vibration and shock resistant.
- 3. Seals
  - a. Gauges attached to systems without particulates shall be equipped with seals. See Section 40 27 60.
- 4. Gauges general as manufactured by:
  - a. Ashcroft Industrial Instruments (Dresser). With Plus Performance.
  - b. Forboro/Jordan, Inc. Equivalent model
- 5. Gauges sleeve pressure as manufactured by:
  - a. Red Valve Co., Inc.
  - b. Ronningen-Petter.
  - c. Onyx.
  - d. No Equal.
- 6. Snubbers as manufactured byL
  - a. Cajon Co.
  - b. Weksler Instruments, Corp.
  - c. Ashcroft.
  - d. No Equal.
- 7. Pulsation dampeners as manufactured by:
  - a. Cajon Co.
  - b. Weksler Instruments, Corp.
  - c. Ashcroft.
  - d. No Equal.

## 2.3 ACCESSORIES

- A. Gauges shall be liquid filled or have some equivalent technology.

## 2.4 SOURCE QUALITY CONTROL

- A. All instruments and/or representative instruments shall be calibrated to in facilities and with instruments traceable to the National Bureau of Standards.
  - 1. Provide complete documentation covering the traceability of all calibration instruments.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine the complete set of plans, the process fluids, pressures and temperatures and furnish instruments that are compatible with installed process condition.

## 3.2 PREPARATION

- A. Coordinate the installation with all trades to ensure the mechanical system has all

necessary appurtenances, weldolets, valves, orientation, etc. for proper installation of the instruments.

### 3.3 INSTALLATION

- A. All instruments shall be installed in strict conformance with the manufacturer's recommendations.
  - 1. It is the CONTRACTOR's responsibility to install all instruments in conformance with manufacturer's recommendations.
  - 2. It is the CONTRACTOR's responsibility to notify the ENGINEER of any installation conditions that may be shown at variance with the manufacturer's recommendations.
- 3. Install two 2 –valve instrument manifolds for each gauge pressure transmitter.
- 4. Bolt 3 valve manifolds at non-flange diaphragm type differential pressure transmitters in place of standard flange adapters.
- 5. Install root valves at process taps except insertion elements.
- 6. Install gauge valves on process connections to instruments where multiple instruments are connected to one tap or where root valves are not readily accessible.
- 7. All gauges shall be installed with the face in the vertical position.
- 8. In strict accordance with the manufacturer's printed instructions.
- 9. At the locations shown on the drawings, when so shown.
- 10. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges.
- 11. In extreme cases, and with the approval of the ENGINEER, gauges may be mounted independently, with flexible connectors.

### 3.4 FIELD QUALITY CONTROL

- A. The Instrumentation and Control Systems Contractor shall calibrate all instruments in the field during the Calibration and Loop Validation Tests as identified in Section 40 10 00.

### 3.5 ADJUSTING

- A. All instruments shall be field verified.

### 3.6 DEMONSTRATION

- A. Performance of all instruments shall be demonstrated to the ENGINEER prior to commissioning.

### 3.7 PROTECTION

- A. All instruments shall be fully protected after installation and before commissioning.  
The CONTRACTOR shall replace any instruments damaged prior to commissioning.



1. The ENGINEER shall be the sole party responsible for determining the corrective measures.

### 3.8 SCHEDULES

- A. The following instrument data sheets are included as a guideline for the supply of the instruments. These sheets are not complete and the instrument selection shall be the CONTRACTOR's responsibility. Changes may be made to the instrument materials, ranges, etc. as part of the submittal review. The CONTRACTOR shall provide documented evidence for a differential, plus or minus, that results from these changes.
- B. The CONTRACTOR shall supply complete instrument data sheets for each and every instrument and submit this information in accordance with paragraph 1.05 of this section.
  1. Instrument data sheets shall be furnished in both hard copy and electronic format.

**END OF SECTION**

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**SECTION 40 91 21**  
**TEMPERATURE TRANSMITTER**

**PART 1 - GENERAL**

**1.1 THE REQUIREMENT**

- A. The Contractor shall furnish, test, install, and place into satisfactory operation the pressure transmitters, with all spare parts, accessories, and appurtenances as herein specified and as shown on the Drawings.

**1.2 RELATED WORK SPECIFIED ELSEWHERE**

- A. Section 40 10 00 – Process Control and Information Systems
- B. Section 40 20 00 – Instruments, General

**PART 2 - PRODUCTS**

**2.1 TEMPERATURE TRANSMITTERS**

**A. Room Temperature Transmitters**

- 1. Pressure transmitter shall be 24-28 VDC powered from PLC panel power supply, Foxboro I/A Series, or equal. Power supply shall be VDC powered from PLC panel power supply. Transmitter shall be wall mounted with bare transducer element below sensing room temperature. Signal output shall be 4 to 20 mA.
- 2. Temperature transducer shall be RTD type. Element shall be bare connected directly to transmitter. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be +/- 0.0 degrees Fahrenheit.

**B. Water Temperature Transmitters**

- 1. Pressure transmitter shall be 24-28 VDC powered from PLC panel power supply, Foxboro I/A Series or equal. Signal output shall be 4 to 20mA. Transmitter shall be wall mounted with conduit for RTD cable.
- 2. Temperature transducer shall be RTD type. Element shall be submersible and connect to submersible RTD cabling with submersible connection. Adjustable dampening shall be provided. External zero adjustment shall be provided. Accuracy shall be +/- 0.1 degrees Fahrenheit.

**PART 3 - EXECUTION**

**3.1 REQUIREMENTS**

- A. Refer to Section 40 20 00.

**END OF SECTION**

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**SECTION 40 91 23**  
**MISCELLANEOUS PROPERTIES MEASUREMENT DEVICES**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. This section covers the Work necessary to install a ready to use and tested process and analysis system. CONTRACTOR shall provide all components required for a complete and functional system.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN WATER WORKS ASSOCIATION (AWWA)
  - 1. AWWA C 207 Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
  - 2. AWWA C 751 Magnetic Inductive Flowmeters
- C. NSF INTERNATIONAL (NSF)
  - 1. NSF/ANSI 61 Drinking Water System Components - Health Effects

**1.4 SUBMITTALS**

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. Submit catalog cuts on all process equipment including: switches, meters, sensors, or other items shown on Contract Drawings referencing each item by mark number. Information shall indicate manufacturer specification compliance and dimensional data.
- C. CONTRACTOR shall supply operation and maintenance manuals for all process equipment.

**1.5 WARRANTY**

- A. Manufacturer shall provide to OWNER written guarantee against defects in material or workmanship for a period of one (1) year.

## **1.6 DELIVERY AND STORAGE**

- A. All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants. Each system shall be factory calibrated and certified prior to delivery.

## **1.7 QUALITY ASSURANCE**

- A. Equipment to be furnished under this section shall be the product of manufacturers regularly engaged in the design and manufacturing of this type of equipment. The manufacturer shall assume responsibility for, and guarantee performance of equipment furnished. However, this shall not be construed as relieving CONTRACTOR from responsibility for the proper installation and functionality of the work.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. Each process measurement system shall typically consist of a sensor and analyzer/transmitter. Where shown on the Contract Drawings, the analyzer/transmitter may be utilized for multiple sensors. When an analyzer/transmitter is used for multiple sensors, it shall be capable of displaying simultaneously each process measurement.
- B. Each analyzer/transmitter shall be equipped with a means to transmit process measurement data to the plant SCADA system.
  - 1. For hardwired signals, unless indicated otherwise in Contract Drawings, provide the following:
    - a. 4-20 mA output signals for each process measurement (for up to 500 Ohm loads).
    - b. Two programmable SPDT relay outputs, rated at 5A up to 230 VAC, for each process measurement.
  - 2. Where shown on the Contract Drawings, provide the following digital communications to the plant SCADA system:
    - a. HART Protocol
    - b. PROFIBUS
    - c. MODBUS
- C. Each analyzer/transmitter shall be powered by 115VAC (+/- 10%) at 60 Hz unless shown on Contract Drawings as being powered by 24 VDC (+/- 15%). Each analyzer/transmitter shall retain its programmable settings in non-volatile memory. Battery powered instruments, analyzer, or transmitters will not be accepted.
- D. Each sensor and corresponding analyzer/transmitter shall be supplied as a complete and operable system. This includes all cabling, mounting hardware and fasteners. When installed outdoors, the analyzer/transmitter shall be protected from the sun such that direct sunlight will not shine on the display.
- E. All analyzers/transmitters shall be waterproof and made from corrosion resistant materials.

- F. All sensors to be immersed in liquids shall be rated for permanent submersion and shall be corrosion resistant.

## 2.2 MAGNETIC FLOW METERS

- A. Magnetic flow meters shall be the low frequency induction type which produces a DC pulsed signal directly proportional to and linear with the flow rate. Liners shall be polyurethane. Flow meters shall be rated at 250 psi. Standard output shall be an analog 4-20 mA signal with a local indication from a liquid crystal display (LCD) reading in gallons per minute flow. The meter shall also have a totalizer (with pulsed output), and non-full pipe detection. Meters shall have a minimum of 2 self-cleaning electrodes. CONTRACTOR shall field verify length of cable for connection.
- B. Flanged connections shall be constructed of Type 304 or Type 316 stainless steel with pressure ratings to match the connecting pipe.
- C. Liner shall be polyurethane or PTFE and electrodes stainless steel suitable for potable water service. Liners and electrodes for service other than potable water shall be constructed of materials conforming to the manufacturer's recommendation for the intended service.
- D. Meter housing shall be rated for NEMA 6 for submersible operation.
- E. Meters shall include grounding rings.
- F. The transmitter shall have six digit LCD displays for flow rate, percent of span, and totalization; be capable of measuring flow in both directions; automatic range change; capability to convert DC pulse signal from the tube to a standardized 4 to 20 mA DC signal into a minimum of 700 ohms; self-diagnostics and automatic data checking, and a scaleable frequency output, 0 to 100 Hz.
- G. The flow measuring system shall conform to the following:
  - 1. Time constant: 0.5 to 1000 seconds; galvanic or optic isolation
  - 2. Accuracy: 0.50 percent of flow rate from 10 to 100 percent full scale velocities over 3 feet per second.
  - 3. Repeatability: 0.25 percent of full scale
  - 4. Power consumption: 30 watts or less
  - 5. Power requirements: 120 VAC, plus or minus 10 percent, unless indicated otherwise on the Contract Drawings. Battery powered flow meters will not be accepted.
- H. Magnetic flow meters shall be **Proline Promag W400 by Endress+Hauser, 8700 Series by Rosemount, SITRANS MAG 3100 by Siemens** or approved equal.

## 2.3 PRESSURE SWITCH

- A. A high-pressure cutoff switch shall be installed as shown in the Contract Drawings and shall be as specified in the Electrical Drawings. The switch setting shall be adjustable as specified in the Contract Drawings. The switch shall be rated for the pressure of the system where it is installed with a safety factor of 1.5.

## **2.4 PRESSURE TRANSMITTER**

- A. The pressure transmitter shall be an electronic pressure transducer tailored to the installation as shown on the drawings and suitable for the planned application. The system shall include a pressure transducer with integral diaphragm seal. The pressure transmitter shall operate on 24 VDC, and shall provide a 4-20 mA DC signal to the RTU panel. The loop signal shall measure the water pressure and have a 4-20 mA signal output. The pressure transmitter shall have a LCD display showing the pressure in "psi". The pressure transmitter shall be coded "DW" for NSF drinking water certification. Pressure transmitters shall be **Rosemount Series 3051**, or approved equal.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. All equipment shall be mounted and installed as per manufacturer's recommendations. Coordinate final location with ENGINEER.

### **3.2 FLOW METER FIELD QUALITY CONTROL**

- A. Each instrument shall be tested before commissioning and ENGINEER shall witness the interface capability in the PLC control system and associated registers.
  - 1. Each instrument shall provide direct programming capability through the PLC
  - 2. Each instrument shall provide direct control of totalizer reset functions through the PLC
  - 3. Each instrument shall be supported with a device profile permitting direct integration in the PLC
- B. ENGINEER shall witness all instrument verifications in the field.
- C. Manufacturers Field Services shall be provided for start-up and commissioning by a Factory field service representative or a manufacturer's authorized service provider (ASP).
  - 1. Manufacturer representative shall verify installation of all installed flow tubes and transmitters.
  - 2. Manufacturer representative shall notify ENGINEER in writing of any problems or discrepancies and proposed solutions.
  - 3. Manufacturer representative shall perform field verification at the time of installation for long-term analysis of device linearity, repeatability and electronics health. A comparative report shall be generated for each meter tested.
  - 4. Manufacturer representative shall generate a configuration report for each meter.

### **3.3 TESTING**

- A. After installation of the equipment is complete, operating tests shall be carried out to ensure that the equipment operates properly. All piping shall be tested hydrostatically and for leaks. If any deficiencies are revealed during any tests, such deficiencies shall be corrected, and the tests shall be reconducted.

- END OF SECTION -



**SECTION 41 22 13.29**  
**FREESTANDING WORKSTATION BRIDGE CRANE**

**PART 1 GENERAL**

**1.1 SCOPE**

- A. Product: Freestanding Workstation Bridge Cranes include freestanding support structure, two runways, bridge moving perpendicular to runways and equipped with enclosed track, end trucks, hoist trolley, festooning systems, bumpers, and other accessories.
- B. General Design Standards: Cranes shall be designed in conformance with the following applicable standards:
  - 1. Workstation Bridge Cranes: AISC Steel Construction Manual, OSHA 1910.179, ANSI B30.11, AWS D1.1/D1.6, and MMA MH27.2.
- C. Standard Equipment Specifications: List other specifications related to the product and application including options, accessories, and customizations.
  - 1. Runway Length:.....42' – 0"
  - 2. Support Center: .....19' – 6"
  - 3. Header Length:.....35' – 7"
  - 4. Bridge Span: .....32' – 0"
  - 5. Bridge Length: .....34' – 0"
  - 6. Capacity:.....1 Ton
  - 7. Maximum Overall Height: .....15' – 0"
  - 8. Hoist Hook Height:.....10' AFF MIN
  - 9. Construction: Fabricated from ASTM A36 steel sections with finished ends and surfaces.

**1.2 REFERENCES**

- A. American Institute of Steel Construction (AISC): Manual of Steel Construction, Part 5, Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts
- B. American National Standards Institute (ANSI): ANSI B30.11 – Monorails and Underhung Cranes
- C. American Society for Testing and Materials (ASTM) A36: Carbon Structural Steel
- D. American Society for Testing and Materials (ASTM) A325: Structural Bolts, Steel, Heat Treated, 120/150 ksi Minimum Tensile Strength
- E. American Society for Testing and Materials (ASTM) A490: Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
- F. American Society for Testing and Materials (ASTM) B221: Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube

- G. American Welding Society (AWS) D1.1: Structural Welding Code
- H. American Welding Society (AWS): Certified Shop
- I. Occupational Safety and Health Administration (OSHA) – Specification 1910.179: Overhead and Gantry Cranes
- J. CMAA Specifications 70 and 74: Traveling Bridge Cranes
- K. MMA Specification MH27.2: Enclosed Track Underhung Cranes and Monorail Systems

### **1.3 PERFORMANCE REQUIREMENTS**

- A. Coverage: Crane shall provide coverage of rectangular area of size indicated on drawings and consist of:
  - 1. Crane structure must be self-supporting except where attached at its base to primary structural elements. Crane structure may not rely on bracing from primary structure for stability.
  - 2. Two rigid, parallel runways; cranes with more than two runways or with articulating runways are not acceptable.
  - 3. Rigid single or double girder bridge moving perpendicular to runways or monorail.
- B. Modular, Pre-engineered Design: Crane system shall be capable of expansion, disassembly, relocation, and the addition of multiple mixed capacity bridges.
  - 1. Crane shall be designed, fabricated, and installed in accordance with ANSI B30.11 and OSHA 1910.179.
- C. Productivity Ratio: Crane shall be designed to move load manually with maximum force of approximately 1/100 load weight.
- D. Deflection Guidelines: All Workstation Bridge Crane models are designed with maximum deflection of approximately L/450.
- E. Crane Operating Temperature: 5 to 200 degrees F (-15 to 93 C)
- F. Structural Design: The crane's structural design is based on live load capacity plus 15 percent for hoist and trolley weight and 25 percent for impact. Contact manufacturer for assistance specifying cranes that will require seismic and other additional loads or cranes that will operate in high humidity or corrosive environments. Crane shall be designed to withstand:
  - 1. Crane and hoist dead load.
  - 2. Live load capacity equal to net rated hook load.
  - 3. Inertia forces from crane and load movement and from seismic accelerations.

### **1.4 SUBMITTALS**

- A. CONTRACTOR shall provide the following Submittals in accordance with Section 01 33 00 - Submittal Procedures:

1. Product data for the crane and all accessories. Product data provides capacities, performance, standard operation, and applied forces to foundation.
2. Shop drawings, which outline crane configuration, dimensions, construction, and installation details, including attachment of the base to primary structure.
3. Manufacturer's Warranty
4. Manufacturer's Installation Instructions
5. Manufacturer's Operation and Maintenance Manual

## 1.5 QUALITY ASSURANCE

- A. A. Standard cranes shall be designed, fabricated, and installed in accordance with ANSI B30.11, MH27.2, OSHA 1910.179, and International Building Code. The manufacturer shall assure the safety and quality of all systems when installed and maintained according to their Installation and Maintenance Manual. All Workstation Bridge Cranes shall be designed to withstand the worst seismic condition in the continental U.S. as defined by the IBC.
  1. Applications where cranes will be used in potentially hazardous environments or explosive environments require special consideration. Per the International Building Code, these special conditions must be disclosed prior to placing an order.
  2. Applications where cranes will be used in essential facilities, such as fire departments, military buildings, or communications buildings, or at locations closer than 15km to known seismic sources, require special consideration. Per the International Building Code, these special conditions must be disclosed prior to placing an order. This pump station meets criteria for an essential facility.
  3. Custom cranes may need modification to conform to IBC requirements due to the customized and non-standard nature of these designs.
- B. Manufacturer's Qualifications: An ISO 9001:2015 registered company with more than 40 years of experience successfully designing and manufacturing cranes and material handling solutions for numerous industries.
- C. Installer's Qualification: A company that is acceptable to the crane manufacturer and with five years of experience assembling and installing cranes for multiple applications. Installer should be able to:
  1. Perform welding using certified welders in accordance with AWS D1.1.
  2. Bolt connections in accordance with torque tightening procedures specified in AISC Manual, Part 5.  
Clearly label crane with rated load capacity with label visible from floor level and loading position.
  3. Perform OSHA Load Test Certification.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Included on manufacturer's standard form and outlines the manufacturer's agreement to repair or replace assemblies and components that fail in materials and/or execution within warranty period from date of substantial completion.
  1. Warranty covers defects in equipment material and workmanship of manual systems and equipment for ten (10) years or 20 thousand (20,000) hours, commencing on the date of shipment to the first retail purchaser. This warranty extends to non-wearable

- parts only, with the exception of the wheels supplied on manually operated workstation end trucks and hoist trolleys.
2. Warranty covers two (2) years for paint and finishes for non-aluminum components.
  3. Warranty covers one (1) year for motorized systems and equipment.

## **1.7 DELIVERY, STORAGE, AND HANDLING**

### **A. Project Conditions**

1. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimal results.
2. Do not install products under environmental conditions outside manufacturer's absolute limits.

### **B. Delivery, Storage, and Handling**

1. Store products in manufacturer's packaging until ready for installation.
2. Store and dispose of solvent-based materials in accordance with the requirements of local authorities.

## **PART 2 PRODUCT**

### **2.1 MANUFACTURERS**

- A. Spanco, Inc., Model TR, Morgantown, PA and Las Vegas, NV; 800-869-2080
- B. Or approved equal

### **2.2 FREESTANDING WORKSTATION STEEL BRIDGE CRANE**

- A. Construction: Fabricated from ASTM A36 steel sections with finished ends and surfaces.
- B. Design Factors: Crane shall be designed with a factor of 15 percent of the rated capacity for hoist and trolley weight and 25 percent of the rated capacity for impact. This design provides a margin to allow for variations in material properties, operating conditions, and design assumptions. No crane should ever be loaded beyond its rated capacity.
- C. Service Factor: Crane shall be designed for moderate usage (Class C Normal/Industrial service) as defined:
  1. System or equipment is used where lifted loads average 50 percent of the rated capacity with five to ten lifts per hour, averaging 15 feet, not over 50 percent of the lifts at rated capacity.
  2. Applications involving vacuums, magnets, and other high-impact lifters may be considered severe usage and require special design considerations. Please contact manufacturer for special design pricing.
  3. Consult manufacturer for usage other than moderate and all instances of high-cycle rates or high-impact applications, such as high-speed air or electric hoists, vacuum lifters, or magnets.
- D. Support Structure: Support crane runways with frames consisting of two columns and horizontal header.

1. Columns: Square tubes with full bottom base plate (weld on angles not permitted) and top header plate.
  2. Header: Fabricated from singlewide flange beam. Includes clamp plates, minimum grade 5 bolts, lock washers, and hex nuts for attaching header to column.
  3. Hanger Assemblies: Includes each support frame with pair of hanger assemblies that provide a rigid connection for suspending runways. Assemblies to consist of clamp angles, clamp plates, minimum grade 5 bolts, lock washers, and hex nuts. Use of threaded rods in flush hanger assemblies not permitted.
- E. Runways: Vertical truss fabricated from square steel tubes and enclosed steel track.
1. Track: Enclosed, cold formed, steel box track that serves as bottom cord of runway and permits end trucks and festoon carriers to ride on lower inside flanges. Fabricate lower running flanges with flat surface for higher durability and wheel contact. Sloped flanges not permitted.
  2. Splice Joint: Includes truss splice plates, channel-shaped track splice joints, bolts, lock washers, and nuts for joining runway sections. Splice joints must be located within four feet of a support point.
  3. Runway Cantilevers: Up to four feet of cantilever is allowed from a hanger location to the end of the runway for trussed track. Up to two feet of cantilever is allowed from a hanger location to the end of the runway for plain track.
- F. Festoon stack section: Includes enclosed track extension to allow for stacking festoon carriers at end of runway.
- G. Bridge, Enclosed: Cold formed steel box track that permits hoist trolleys and festoon carriers to ride along track's lower inside flanges. Fabricate lower running flanges with flat surfaces. Sloped flanges not permitted.
- H. Bridge, Extruded Aluminum: Enclosed track reinforced with extruded aluminum beam.
1. Included as either single piece extrusion or with separate beam welded to track. Bolted reinforcing not permitted.
  2. Track: Enclosed box track designed for trolleys and festoon carriers to ride on lower inside flanges. Fabricate lower running flanges with flat surfaces. Sloped flanges not permitted.
- I. End Trucks: Rigid frame end truck designed to ride inside enclosed runway track and connect to and suspend bridge.
1. Construction: Stamped steel fabrication with both vertical and horizontal wheels to prevent binding in runway.
  2. Wheels: Removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be flat to match track profile. Non-removable or non-tapered wheels are not acceptable. Polyamide wheel material is provided by manufacturer. Steel wheels are optional.
  3. Drop Lugs: Included on both sides of truck to limit truck drop in the event of wheel or axle failure.
  4. Connection to the Bridge: Includes a sliding or flexible connection between bridge and end truck. Rigid connections or articulating connections with threaded hardware are not acceptable.

- J. Hoist Trolley: Rigid-body trolley designed to ride inside enclosed track of bridge and to carry hoist and load. Articulating trolleys are not acceptable.
1. Construction: Two-piece stamped steel body with two wheels on each side and tapered clevis positioning hoist hook at center of trolley, so load weight is evenly distributed to all four trolley wheels. Includes removable clevis pin (type and size determined by manufacturer for specified capacity). Trolleys with non-removable clevis pins are not acceptable. Holes provided in body for mechanical connections.
  2. Wheels: Removable, self-centering wheels with sealed lifetime lubricated bearings. Vertical wheels shall be flat to match track profile. Non-removable or tapered wheels are not acceptable. Polyamide wheel material provided by manufacturer. Steel wheels are optional.
  3. Drop Lugs: Included on both sides of trolley to limit trolley in the event of wheel, axle, or load bar failure.
  4. Designed for hook attachment of hoist.
- K. End Stops: Molded composite, resilient bumper installed in runway and bridge tracks to prevent end trucks, hoist trolley, and festoon carriers from rolling out of track. Bolt stops without energy absorbing bumper are not acceptable.

## **2.3 SYSTEM OPTIONS**

### **A. Tractor Drives**

1. Motorization available for bridge, trolley, or both.
2. Power Bridge or trolley and hoist trolley on straight 600, 700, or 900 series track (1,000 to 4,000 pound capacities) runways or monorails.
3. 480 volts, three phase, 60 hertz, electric operation.
4. Standard speeds from 34 F.P.M. to 75 F.P.M. Other speeds are available.

### **B. Cantilevered Bridges**

1. One or both ends of crane bridges can be cantilevered beyond standard 12-inch overhang. Consult manufacturer for specific applications.

### **C. Festoon Assemblies**

1. Includes length of cable and/or air hose to supply lifting device.
2. Festoon Trolleys: Four wheeled trolleys with pivoting saddle and applicable attachment to support service run in enclosed track and allow festooning as hoist trolley travels. Festoon gliders are not acceptable.
3. Festoon Clamp: Steel clamp assembly attached to track to prevent festoon trolleys and gliders from exiting track.

## **2.4 SYSTEM COMPONENTS**

### **A. End Stop Bumper for Enclosed Track System**

1. End stops are equipped with resilient rubber bumpers to increase impact resistance and are through bolted to the enclosed track.
2. Standard on all enclosed track bridge crane systems.

B. Cable/Hose Trolley for Enclosed Track System

1. Standard on all workstation bridge crane kits.
2. Utilized for conveying the power supply flat cable or round air hose.
3. Four wheels ensure easy movement.
4. Pivoting clevis provides swiveling action for flat cable or air hose.
5. Maximum 1/2-inch air hose on standard trolley.

C. Festoon Section for Enclosed Track System

1. Furnished for end of one runway to allow stack-up of cable/hose trolleys.
2. Through bolted to runway track profile. Festoon trolleys pass under through bolt into festoon section.
3. Standard on all workstation bridge crane systems.

D. End Truck for Enclosed Track System (End trucks provide smooth running connection between enclosed track workstation bridge crane and runway track.)

1. Standard wheels are large diameter polyamide, equipped with anti-friction ball bearings(steel wheels optional).
2. Bronze wheels and guide rollers are available for "spark-resistant" applications.
3. Placement of horizontal steel guide rollers on either end of the truck guards against "crabbing" of workstation bridge crane.
4. Zinc chromate plated finish.

E. Hoist Trolley for Enclosed Track System

1. Fabricated from precision cut steel plate.
2. Equipped with large diameter polyamide wheels with anti-friction ball bearings to ensure smooth and easy movement (steel wheels optional).
3. Bronze wheels and rollers are available for "spark-resistant" applications.
4. Zinc chromate plated finish.

F. Cable/Hose Clamps for Enclosed Track System

1. Fitted at one end of runway and bridge to hold cable or hose.
2. Flat cable 4 wire #14 A.W.G. supplied standard on all systems.
3. 3/8 and 1/2-inch air hose optional.

G. Vacuum Hose Trolley for Enclosed Track System

1. Special free moving trolleys with kick-up rollers and Velcro straps are provided to festoon vacuum hose on vacuum lifter applications.

H. Hanger Assembly for Enclosed Track System

1. All freestanding workstation bridge cranes are provided with flush type hanger assemblies, which allow for adjustment in both lateral and longitudinal directions.
2. Hangers are of appropriate size and numbers for selected system.

I. Flat Cable Festooning Systems (four wires #14 A.W.G.) for Enclosed Track

1. Supplied with all bridge crane systems.

2. Optional, various sized air hoses available.
3. Recommended festoon loops are 18 inches for bridges and 36 inches for runways.

J. Runway and Bridge Beams for Enclosed Track System

1. Trussed track available in four profiles and 14 standard trusses with capacities ranging from 250 to 4,000 pounds.
2. Standard maximum support centers of 20, 25 or 30 feet.
3. Custom support centers up to 40 feet, depending on capacity.

K. Track Splice Assemblies for Enclosed Track System

1. Slide over track profile to ensure proper alignment.
2. Trussed track splice assembly bolts through top chord to prevent joints from separating.

## **2.5 SHOP FINISHING**

A. Standard Paint Colors:

1. All runways and structural supports are painted with Spanco Standard Gray Industrial Enamel.
2. All bridges are painted Spanco Yellow Industrial Enamel.
3. Ford® Tractor Blue Industrial Enamel is available at no additional cost.
4. Systems can be painted any custom color for an additional cost.

B. Surface Preparation and Painting Procedures:

1. Adhere to the standards of the Society for Protective Coatings (SSPC) for all product surface preparation.
2. Crane components shall be deburred and descaled using power tools equipped with sanding discs and wire wheels prior to painting.
3. Components are washed with high-pressure/high-temperature biodegradable degreaser solution.
4. All components are coated with quick drying, semi-gloss enamel, applied to a minimum dry-film thickness of two to three mils.
5. A finishing coat is applied with a hot airless electrostatic spray paint system.
6. Painted components are cured at air temperature.

## **PART 3 EXECUTION**

### **3.1 PREPARATION**

A. DO NOT start installation until support structures are properly prepared.

B. Inventory:

1. Check materials to ensure all parts are present.
2. Anchor bolts for support columns are not included. Four 13/16-inch diameter holes are provided for anchor bolts.

C. Motorized tractor drive:



1. Check electrical supply, conduit, wiring, disconnect switch, and other electrical components.

D. Foundation

1. Check concrete footings, slabs, or other foundations to ensure sufficient system support.
2. Ensure accurate anchor bolt patterns are provided for foundation design.

### 3.2 INSTALLATION

- A. Units and accessories must be installed in accordance with manufacturer's instructions and shop drawings.

- B. Do not modify crane components without manufacturer's approval.

- C. Clearances for moving crane components:

1. Minimum vertical clearance: Three inches from any overhead obstruction.
2. Minimum horizontal clearances: Two inches from any lateral obstruction.
3. Prior to applying proper torque to the bolts, ensure runways are:
  - a. Level to within plus or minus 1/8 inch in 20 feet .
  - b. Parallel with opposite runway to within plus or minus 1/8 inch every 20 feet.

- D. Column and Header Installation

1. Arrange installation area, position columns, and verify orientation. Bolt columns to floor and attach header beam to columns with 5/8-inch fasteners. Torque fasteners to 108 foot-pounds.
2. Follow the same procedure for subsequent sets of columns and headers.

- E. Runway Installation

1. Raise runway track into position and clamp it to header beams with 5/8-inch fasteners. Torque fasteners to 108 foot-pounds.
2. Do not cantilever ends of runway tracks more than specified on manufacturer's drawing.
3. Center of runway is located approximately 14 inches from inside edge of support column.
4. OSHA regulations require a minimum clearance of two inches from end of bridge track to face of support columns or other obstructions.

- F. Splice Installation

1. For systems with more than one section of runway track, additional section is installed in the same manner, with the addition of splice joint assembly.
2. Plain Track: Splice joints must be within 12 inches of a support bracket or hanger.
3. Trussed Runway: Splice joints must be within 48 inches of a support bracket or hanger.
4. The track splice joint is made using a sleeve with eight set screws threaded into top and sides. Slide sleeve over end of first runway track and butt second runway track

against first. Center sleeve over joint. Center top set screws should be tightened to push tracks against base of sleeve, so bottom surfaces of track are even.

5. Adjust side set screws so track slots are aligned and there is a smooth transition from one track to another. Tighten all top set screws then side sets crews for correct track alignment. Do not overtighten screws.
6. Trussed runway splice joints also include two splice plates and four 1/2-inch bolts with nuts and lock washers. Install splice plates to connect ends of truss top tubes with the four through bolts provided. Torque through bolts to 50 foot-pounds.
7. When end stop hole in runway or track aligns with sleeve set screw, move sleeve approximately 1/4-inch to either side of end stop hole.

#### G. Bridge End Truck Installation

1. Insert bridge track into end truck sleeves. Locate center of end trucks approximately 12 inches from ends of bridge. One end truck is secured to bridge track with set screws and one end truck is allowed to slide freely on bridge track.
2. Install bridge crane by inserting end trucks of runway tracks at one end of runway. Adjust and tighten bridge end truck setscrews to provide a minimum clearance of two inches between ends of bridge and support columns.

#### H. Runway End Stop Installation

1. Secure end stop assemblies, end stop bolts, and locknuts at both ends of runway tracks, except for end of festoon storage area, where applicable.

#### I. Festoon Track Extension Installation

1. Install festoon trolleys and cable in runway. Use the following trolley spacing:
  - a. Bridges: 18-inch loops, approximately
  - b. Runways and Monorails: 36-inch loops, approximately
2. Place festoon track extension on end of runway as close as possible to power junction box. Align festoon track extension prior to tightening bolts. Adjust bolts on side of festoon track extension to ensure alignment of bottom flanges of track. Clamp festoon track extension firmly into a straight level position prior to tightening top of extension. Check to ensure all surfaces of track ends and festoon track extension are in contact.
3. Tighten top bolt to:
  - a. 400 Series 12 foot-pounds
  - b. 500-900 Series 17 foot-pounds
4. 400 Series Track: Install bolt in top of festoon track extension. Place flat washer and locknut on bolt and tighten. Do not place end stop at this location. Using end stop supplied with system, install in end of festoon track extension.
5. 500-900 Series Track: Install bolt through side of festoon track extension. Place flat washer and locknut on through bolt and tighten. Do not place end stop or end stop bumper at this location.
6. Use end stop supplied with system and install in end of festoon track extension according to installation instructions.
7. All end stop bolts must have rubber bumper to ensure festoon trolleys remain in track.
8. Ensure all end stop warning labels are in place.
9. Install festoon end clamp to secure festoon cable at end of festoon track extension.
10. Ensure trolleys slide across runway and festoon track extension joint smoothly.

11. Ensure all trolleys stack properly in festoon track extension area, clear through bolts, and contact end stop.

J. Runway Festoon Installation

1. Install festoon trolleys into storage area of runway track if system includes festooning.
2. Secure end stop bolts and rubber bumpers. Locate and secure festoon end clamps. Install festoon cable on festoon trolleys at equal spacing.
3. Festooning can be located on either end of the runway.

K. Hoist Trolley and Bridge Festoon Installation

1. Install hoist trolley and festoon trolleys on bridge track. Secure end stop bolts and rubber bumpers. Install festoon cable on festoon trolleys at equal spacing. Festoon storage area is within bridge length.
2. To prevent personal injury or death, DO NOT operate crane without end stop through bolts securely in place.
3. Once installation is complete, bridge and runways should be leveled. Check tightness for all bolts and nuts.

L. Hoist Installation

1. Attach hoist to the hoist trolley. Use washers on hoist mounting pin to center hoist inside hoist trolley. Reinstall washers on outside of hoist trolley (both sides) before installing or reinstalling cotter pins to secure hoist-mounting pin. Replace cotter pin(s) if worn or broken. Bend cotter pin around mounting pin.
2. Do not operate hoist or crane if cotter pins are not in place and properly bent over on both sides of hoist trolley. Check regularly that cotter pins are in place and securing hoist on hoist trolley.

### **3.3 FIELD QUALITY CONTROL**

A. Inspection

1. Verify all bolts are tightened to torque values specified in manual and lock washers are fully compressed.

B. Field Test

1. Ensure crane operates properly (movement is smooth and consistent).
2. Verify motorized operation and controls function properly
3. Make adjustments as needed and correct inadequacies.

C. Acceptance Test

1. After the enclosed track crane system has been installed, OSHA requires an acceptance test before operating and after any modifications. An authorized dealer or installer should perform acceptance tests.

D. Maintenance

1. A system inspection should be performed 30 days after installation. All nuts, bolts, and screws should be checked for tightness. All end stops, cotter pins, and hoist trolleys should be checked for abnormal wear or breakage. Check track splices for alignment and verify that end trucks and festoon trolleys travel smoothly through joints. Check that festoon cables and hoses are securely clamped to festoon trolleys and end clamps.
2. A complete inspection of all fasteners and connections should be performed annually or every two thousand (2,000) hours. Heavy conditions of use may require more frequent inspections.
3. Operators should visually inspect the system before each use to note any unusual or abnormal system operations.

E. Clean Surfaces

1. Touch up scratches and blemishes with matching paint from manufacturer.
2. Keep surfaces clean and clear of build-up and residue.

F. Protect Crane

1. Protect installed products until completion of project.
2. Touch up, repair, or replace damaged products before substantial completion.

- END OF SECTION -

**SECTION 43 24 10**  
**VERTICAL TURBINE PUMP AND MOTOR**

**PART 1 GENERAL**

**1.1 DESCRIPTION**

- A. Furnish, deliver, and install a short set, solid shaft, vertically suspended pump, double casing (inline suction barrel), discharge head, and appurtenant work, complete and operable, as shown in the Contract Drawings. The pump shall also be provided with a vertical squirrel cage induction motor with a Weather Protected Type I (WPI) enclosure.
- B. The pump manufacturer shall be made responsible for furnishing the Work and for the coordination of design, assembly, testing, and installation of the Work. CONTRACTOR shall be responsible to OWNER for compliance with the requirements of each pump.
- C. Where 2 or more pumps of the same type or size are required, provide pumps produced by the same manufacturer.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 26 05 74 Electric Motors
  - 3. Section 33 12 00 Mechanical Appurtenances
  - 4. Section 33 13 00 Pipeline Testing and Disinfection

**1.3 REFERENCES**

- A. Work covered by this Specification shall meet or exceed the provisions of the latest editions of the following Codes and Standards in effect at the time of award of the Contract. The publication is referred to in the text by basic designation only.
- B. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
  - 1. ANSI B16.1            Gray Iron Pipe Flanges and Flanged Fittings Class 25, 125, and 250
- C. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
  - 1. ASTM A 36            Standard Specification for Carbon Structural Steel
  - 2. ASTM A 48            Standard Specification for Gray Iron Castings
  - 3. ASTM A 53            Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - 4. ASTM A 108           Standard Specification for Steel Bars, Carbon and Alloy, Cold Finished
  - 5. ASTM A 536           Standard Specification for Ductile Iron Castings
  - 6. ASTM A 564           Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes
  - 7. ASTM A 582           Standard Specification for Free-Machining Stainless Steel Bars
  - 8. ASTM B 505           Standard Specification for Copper-Alloy Continuous Castings

9. ASTM B 584      Standard Specification for Copper Alloy Sand Castings General Applications

D. AMERICAN WATER WORKS ASSOCIATION (AWWA)

1. AWWA C 651      Standard for Disinfecting Water Mains
2. AWWA E 103      Standard for Horizontal and Vertical Line-Shaft Pumps

E. NSF INTERNATIONAL (NSF)

1. NSF 60              Drinking Water Treatment Chemicals
2. NSF 61              Drinking Water System Components – Health Components
3. NSF 372             Drinking Water System Components – Lead Content
4. NSF 600             Health Effects Evaluation and Criteria for Chemicals in Drinking Water

## 1.4 SUBMITTALS

- A. Provide submittals in accordance with Section 01 33 00 – Submittal Procedures.
- B. CONTRACTOR shall submit for review to ENGINEER, sufficient literature, detailed specifications, and drawings to show dimensions, make, style, speed, size, type, horsepower, head-capacity, efficiency, materials used, design features, internal construction, weights, and any other information required by ENGINEER for review of all pumping equipment. No pumping equipment will be accepted, and installation will not be allowed, until such review has been completed. All submittals shall clearly state any deviations from the specified requirements. The following shall also be furnished with the submittal:
  1. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. The equipment manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the specified design point.
  2. Equipment manufacturer shall provide complete and detailed information regarding the installation of the pumps. Any installation requirements or operating conditions which the supplier or manufacturer considers to be critical to the safe and reliable operation of the pumps should be identified and described in detail.
  3. Shop drawings submitted for review also shall include electrical diagrams, schematic control diagrams, and a detailed description of how the control system is to function.
  4. Submit performance curves at intervals of 100 rpm from minimum speed to maximum speed for each pump equipped with a variable speed drive.
- C. Submit signed, dated, and certified factory test data for each pump which requires factory testing. Submit these data before shipment of equipment.

## 1.5 MECHANICAL DEFECTS AND REJECTIONS

- A. CONTRACTOR furnished pumps that have mechanical defects or do not meet the requirements for head-capacity, horsepower, efficiency, and vibration requirements will be rejected, and shall be replaced by CONTRACTOR without additional cost to OWNER for furnishing, removal, reinstallation, and retesting. Mechanical defects shall include

excessive vibration, improper balancing of any rotating parts, improper tolerances, binding, excessive bearing or motor heating, defective materials, including materials that do not conform to the Specifications, improper fitting of parts, and any other defect which will in time damage the pump or unreasonably impair its efficiency or operation.

## **1.6 WARRANTY**

- A. CONTRACTOR furnished equipment covered by these specifications shall be warranted against defective parts due to faulty material or workmanship for one (1) year after date of start-up and acceptance by OWNER. CONTRACTOR shall guarantee to replace any defective parts within the period of time specified at no additional cost to OWNER. If CONTRACTOR must pull pump to replace defective parts, CONTRACTOR shall guarantee to pull and replace pump at no additional cost to OWNER.

## **PART 2 PRODUCTS**

### **2.1 GENERAL**

- A. Compliance with the requirements below may necessitate modifications to the manufacturer's standard equipment.
- B. Unless otherwise noted, the required shaft horsepower for the entire pump assembly at any point on the performance curve shall not exceed the rated horsepower of the motor or encroach on the service factor.
- C. Provide each pump with a stainless-steel nameplate indicating serial number(s), rated head and flow, impeller size, pump speed, and manufacturer's name and model number.

### **2.2 FACTORY TESTING**

- A. Equipment shall be factory tested and inspected as specified hereinafter. All costs for the tests shall be borne by CONTRACTOR. Performance test should be run with actual speeds of motor to be provided and tests run at half speed and calculated with affinity laws will not be allowed. Conduct the following tests on each indicated pump system:
  - 1. Factory Non-Witnessed Test
    - a. Perform tests using the complete pump system to be furnished, including the project motor.
    - b. For pumps with motors smaller than 100 hp, the manufacturer's certified test motor will be accepted.
    - c. Testing of prototype models will not be accepted.
    - d. Pumps shall meet the requirements of HI 14.6 Grade 1U.
    - e. Conduct the following minimum tests and submit the test results:
      - 1) Hydrostatic Test.
      - 2) Performance Test:
        - a) Conduct performance test at maximum speed, obtain a minimum of 5 hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, and record on data sheets as defined by the Hydraulic Institute standards.
        - b) For variable speed pumps, test each pump between maximum and minimum speed at 100 rpm increments. Use of affinity laws to calculate test results is not acceptable.

- c) Submit pump curves showing head vs. flow, bhp, KVA, KW, and efficiency results.
  - 3) Mechanical Test:
    - a) Submit certification signed by a senior official of the pump manufacturer that the pump shaft horsepower demand did not exceed the rated motor horsepower of 1.0 service rating at any point on the curve.
    - b) Submit test results to ENGINEER for review prior to delivery of the pumps to the Site.
- 2. In the event of failure of any pump to meet any of the requirements, make necessary modifications, repairs, or replacements in order to conform to the requirements of this Section and re-test the pump until found satisfactory.

## 2.3 VERTICAL TURBINE PUMP

- A. The pumps shall be of the vertically suspended turbine type suitable for pumping potable water as shown in the Contract Drawings. All material, manufacturing, and performance standards shall be in compliance with AWWA E 103 and with NSF 60, NSF 61, NSF 372, and NSF 600, as applicable for potable water applications. The NSF certifications shall be for the entire pump assembly from the suction bell, pump bowls, column piping assembly and up to, and including, the discharge head.

### B. Performance Requirements

#### 1. Operating Conditions:

DESCRIPTION	Pump ID Numbers (P-1 & P-2)	Pump ID Numbers (P-3 & P-4)	Pump ID Number (P-5)
Duty	Continuous	Continuous	Continuous
Drive	Variable Speed	Variable Speed	Variable Speed
Ambient Environment	Indoors	Indoors	Indoors
Ambient Temperature (°F)	40 to 80	40 to 80	40 to 80
Ambient relative humidity (%)	20 to 80	20 to 80	20 to 80
Fluid Temperature (°F)	60	60	60
Fluid pH range	6 to 9	6 to 9	6 to 9
Project site elevation (ft above msl)	5,175	5,175	5,175
NPSH Available (ft)	24.6	24.6	24.6
NPSH Required	16.9	14.5	20.1
Pump Lubrication	Product	Product	Product



<b>DESCRIPTION</b>	<b>Pump ID Numbers (P-1 &amp; P-2)</b>	<b>Pump ID Numbers (P-3 &amp; P-4)</b>	<b>Pump ID Number (P-5)</b>
Maximum shutoff head (ft)	297	361	69
Design flow capacity (gpm)	1,000	850	2,000
Design flow total dynamic head (ft)	210	297	45
Pump Setting Depth (ft) (Bottom of Discharge Head to Suction Bell)	26'-1"	26'-1"	25'-10"
Nominal Operating Speed (rpm)	1,800	1,800	1,800
Design flow minimum efficiency (%)	81	83	75
Maximum Bowl Diameter (inches)	11.1	11.1	14.25
Column Size (diameter in inches)	8	8	12
Minimum Shaft Size (inches)	1-1/4	1-1/4	1-1/2
Minimum Barrel Diameter (inches)	16	16	20
Pump Model Number	National J11HC	National J11HC	National H12HC
Maximum Number of Pump Bowls for Designated Barrel Length	4	5	1
Minimum Motor Horsepower (hp)	100	100	50
Utility Power (Phase, Volts, Hertz)	3, 480, 60	3, 480, 60	3, 480, 60
Motor Duty	Inverter Duty Rated	Inverter Duty Rated	Inverter Duty Rated

2. Pump Characteristics - The pump shall be characterized by head capacity curves of steadily decreasing head with increasing capacity. Maximum head shall be at zero flow. The pump shall have a minimum efficiency as provided in the table above during operation against the system head. Pump head-capacity curves shall indicate that

- these losses have been included. Pumps shall have head-capacity curves similar to that of the specified pump. Pumps having curves that show a flatter or near horizontal slope over a section in the head-capacity curve will not be accepted. Curves with head-capacity curves with slopes of the curve flatter than that shown for the specified pump will not be accepted.
3. The pump and motor shall be capable of producing the flow rates and total dynamic heads indicated in the table above.
  4. Motor Characteristics - Under no operating conditions shall the required pump brake horsepower exceed the nameplate rating of the motor being furnished.
  5. The pump shall be designed to operate throughout its entire range without excessive vibration or noise.

#### C. Vertical Turbine Pump Components

1. Pumps
  - a. The vertical turbine pump shall be as manufactured by **National Pump Company, Flowserve, Goulds, American Marsh**, or approved equal, and shall be a multistage bowl assembly.
  - b. Unless otherwise stated herein, the pump shall in all respects conform to the requirements of AWWA E 103 and shall comply with all local and state sanitary and safety regulations.
2. Discharge Head
  - a. The discharge head shall be fabricated steel (ASTM A53 Grade B Pipe and ASTM A 36 Steel Plate), accurately machined and with suction and discharge pipes in line with each other and located 180 degrees apart. Suction and discharge shall be provided with cut grooves for flexible grooved couplings for a working pressure of 350 psi and shall be sized to match the specified system. The top of the discharge head shall have a rabbet fit to accurately locate the vertical hollow shaft driver and have a diameter equal to the driver base diameter (BD). Lifting lugs of sufficient strength to support the weight of the complete unit shall be provided. The base shall be round or square and be machined to match the pump barrel and be capable of withstanding the system inlet pressure without leaking. CONTRACTOR shall modify the pump base dimensions on the Contract Drawings to match supplied head.
  - b. A lifting soleplate shall be supplied and installed, if required by the pump manufacturer.
  - c. The pump manufacturer shall include the method of adjusting the pump impellers at the top of the head shaft. This method shall provide a positive locking device.
  - d. CONTRACTOR shall be responsible for ensuring that the discharge head is structurally and mechanically adequate for the provided and installed pump configuration.
3. Suction Barrel
  - a. The pumps shall be provided with a suction barrel of the same materials as the discharge head. The barrel shall be capable of containing the maximum suction pressure applied to the suction connection. The bottom of the suction barrel shall be supplied with a welded cap for water service. CONTRACTOR may provide a bottom steel plate welded to the bottom of the suction barrel with bolt holes to plumb and level the barrel. Provide anti-vortex vanes on sides and bottom as indicated on the Contract Drawings.
  - b. The barrel shall be equipped with a square base plate which shall be machined and tapped to match the discharge head base flange. The base shall be drilled to

allow the barrel to be secured in place with anchor bolts. Barrel shall be supplied with proper gasket or "O" ring and bolting for application to seal between the barrel flange and the head base flange.

4. Pump Seals

- a. The pump shall have a split type mechanical seal with housing which bolts to the head with an "O" ring seal. The mechanical seal shall be able to be replaced without removing the motor. Mechanical seals shall be 442 High Performance Split Seal by Chesterton, or approved equal. The housing shall have a lower bronze throttle bushing. The housing seal chamber shall accommodate a single sleeved balanced mechanical seal suitable for the maximum pressure developed by the pump and temperature of 100-degree F maximum. Seal materials shall be suitable for potable water and ANSI/NSF 61 certified. A balanced seal shall be mounted on a shaft sleeve. The shaft supplied shall be a one-piece bowl, line, and head shaft where practical of 416 stainless steel material.

5. Column Assembly

- a. The column assembly shall be supplied with ASTM A 53 Grade B steel pipe threaded or flanged with fabricated steel or removable ductile iron A 536 Grade 60-40-18 bearing retainer equipped with suitable lineshaft bearings for the application. Column bearing spacing shall be such that shaft first critical frequency shall be safely above or below the operating resonant frequency.

6. Pump Bowl Assembly

- a. Pump bowl castings shall be of close-grained cast iron ASTM A48 Class 30 or ASTM A536 ductile iron Class 60-40-18 where required to meet the hydrostatic pressure criteria listed above. The water passages shall be free of blowholes, sand holes, and other detrimental defects, shall be lined with porcelain enamel, and shall be accurately machined and fitted. The finished bowls shall be capable of withstanding a hydrostatic pressure equal to twice the head at rated capacity or 1-1/2 times the shut-off head, whichever is greater. Provide bowl wear rings of 416 stainless steel.
- b. The impellers shall be bronze ASTM B584 alloy C83800, enclosed type, and shall be statically balanced, and shall be fastened securely to the impeller shaft with taper split bushings of steel. Impellers shall be adjustable vertically by an external means. Impeller skirt and series case throat area shall be thick enough to allow for machining and wearing at the time of repair.

7. Pump Shaft

- a. The pump shaft shall be of ASTM A582 Grade 416 Stainless Steel turned, ground and polished. It shall be supported by lead-free bronze bearings of ASTM B505 above and below each impeller. The suction case bearing shall be grease lubricated and protected by a bronze sand collar of ASTM B584 alloy C83800. The size of the shaft shall be no less than that determined by AWWA E 103, Section A4.3 Paragraph 4.3.3.

D. Analysis

1. In order to ensure that neither harmful nor damaging vibrations occur to the pump structure at any speed within the specified operating range, the following analysis shall be required:
  - a. Pump manufacturer shall perform a structural frequency analysis of the above ground structural components utilizing a FEA method to ensure that no structural natural frequencies are excited to a degree that would cause measured vibration amplitudes at the top of the discharge head to exceed the requirements of ANSI/HI

9.6.4-2009. When deemed necessary by the experience of the manufacturer, the below ground structural components shall also be included in the analysis.

- b. The FEA method should include the use of ProE/Mechanica or an equivalent software. All pump assembly components, including the motor, shall be represented as solid elements, and if idealizations are used in place of solid elements, then a complete description of method for the idealization shall be included in the report. The analysis shall also include all modes of interest and pictorially represent each mode shape. Modes of interest are defined as those structural frequencies that exist below 120% of the maximum operating speed. When significant modifications are required to lower the system's natural frequency, the pump structure's stresses and deflections shall also be reviewed. Analysis reports shall conclude acceptable operation at the analyzed operating speeds. The design critical frequency shall be at least 20% above or below the operating range of the pump.
2. Manufacturer to provide documentation of the analysis ensuring that the specified requirements have been met, and that documentation should be signed and stamped by the professionally licensed engineer who performed the analysis work.
3. When measured in the direction of maximum amplitude on the pump and motor bearing housings, shall not exceed limits given in the latest ANSI/HI nomograph for the applicable pump type.

## 2.4 MOTOR

- A. Pump motors shall be a vertical solid shaft, premium efficiency, inverter duty electric motor, and shall be sized as noted in the table above. They shall have a non-reverse ratchet, P-base, squirrel cage induction design. Motor shall have Class H insulation with temperature rise as specified by NEMA standards for class of insulation used and shall have a 1.15 service factor.
- B. Thrust bearing shall be chosen to handle the continuous down-thrust as specified by the pump manufacturer with an ABMA an L-10 bearing life of 75,000 hours, and an L-50 bearing life of 375,000 hours. Provisions shall be made for momentary up-thrust equal to 30% of rated down-thrust. The thrust value shall be calculated at curve points 75% to 125% of specified, full speed, flow rate.
- C. The motor shall be suitable for across-the-line starting, soft start, and shall be capable of reduced-voltage starting.
- D. The motor primary thrust bearing shall incorporate a grounding ring to prevent damage from VFD harmonics and/or stray electrical currents. Grounding rings shall be stainless split-type. Ground rings shall be connected to the electrical ground system for the facility. Ground ring manufacturer shall be **Aegis SGR (for up to 500 HP motors)** or approved equal. For motors over 100 HP insulated upper bearings shall be provided. The insulating bearing material shall be alumina oxide or ceramic. Insulated bearing manufacturer shall be **SKF, NTN Corporation, FAG**, or approved equal.
- E. The motor rating shall be such that at design it will not be loaded beyond nameplate rating and at no place on the pump curve shall the loading exceed the service factor.
- F. The motor temperature shall be rated no higher than the allowable operating temperature of the motor thrust and radial bearings and in no case shall it exceed the temperature rating of the insulation class used to wind the motor.

- G. The junction box shall be oversized to accommodate the wiring connection.
- H. See Specification Section 26 05 74 Electric Motors for additional requirements.

## **PART 3 EXECUTION**

### **3.1 INSTALLATION**

- A. Install pump and motor at the location shown on the Contract Drawings and according with manufacturer's recommendations.
- B. All pumps, complete with drive system, in place at the jobsite, shall not exceed acceptable field vibration limits given in the latest revisions of the Hydraulic Institute Standards. All pumps shall be free of static unbalance; shall be free of dynamic unbalance up to the maximum speed of the pump and drive system; shall be free of torsional vibration from 10 percent below the minimum speed to 10 percent above the maximum speed of the pump and drive system; and shall be free of apparent unbalance caused by defective bearings, by close fittings parts which may rub on the rotating parts intermittently, or by loose discs or rotor parts, or unbalanced loads.
- C. The motor/discharge head assembly shall be shimmed with respect to the suction barrel flange to bring the motor/discharge assembly into optimum alignment with any variations that the pump column and line shaft may exhibit from being truly plumb. Such shims must be structurally sound and securely attached. The watertight seal between the discharge head and the suction barrel flange must be maintained.

### **3.2 FIELD TESTS**

- A. After installation, the pump shall be given an operating test to demonstrate freedom from mechanical defects, excessive noise, and vibration. The test shall include operating the pump continuously while throttling the discharge as needed. The operating test shall be performed for a minimum of one hour, or as directed by ENGINEER. Pumps with variable speed drives shall be tested at maximum speed, and at the average and minimum speeds listed under the specification for the pumps. A copy of actual test data shall be furnished to ENGINEER.
- B. Tests for acceptable vibration shall be made, at no additional cost to OWNER, in the field on each pump system, which in the opinion of ENGINEER, seem to have excessive vibration. All field tests shall be running tests with the pump pumping the product for which it is intended, and each pump system shall be tested separately with no other pumps running. All testing shall be done in the presence of ENGINEER. Amplitude as used in this Specification shall mean total peak-to-peak displacement. The required test for acceptable vibration will be the measurement of this peak-to-peak displacement and will be performed with an **IRD Vibration Meter, Model 306; Bently-Nevada TK-8;** or approved equal.

### **3.3 PROTECTIVE COATING**

- A. Coat materials and equipment in accordance with the requirements of Section 09 90 00 Painting and Finishes.

- B. Pump column piping shall be epoxy lined (interior) and coated (exterior) with an NSF 61/600 system.
- C. The discharge head shall be epoxy lined (interior) with an NSF 61/600 system and the exterior shall be epoxy coated per Section 09 90 00.
- D. The pump barrel shall be epoxy lined (interior) with an NSF 61/600 system and the barrel exterior shall be epoxy coated per Section 09 90 00.

### **3.4 DISINFECTING**

- A. Source of Water
  - 1. CONTRACTOR shall assume all responsibility to obtain the necessary water supplies for disinfection of the pumping system.

### **3.5 TESTING PROCEDURE**

- 1. Leakage and pressure testing must be completed prior to disinfection procedures.
- 2. All pump and water piping installed under this Contract shall be disinfected using an approved disinfection method in accordance with the AWWA C 651.
- 3. Heavily chlorinated water shall not be discharged onto the ground. Upon completion of disinfection, Sodium Bisulfite ( $\text{NaHSO}_3$ ) shall be applied to the heavily chlorinated water to neutralize thoroughly the chlorine residual remaining. Water shall be neutralized to less than 1 ppm.
- 4. After approval of disinfection, CONTRACTOR shall flush the new system until the chlorine residual is a maximum of 0.3 ppm.
- 5. At the end of the disinfecting period, a bacteriological test will be performed by OWNER to ensure adequate disinfection and a second test will be taken at the end of an additional 24-hour period after the first test. If either of the tests fails to provide satisfactory bacteriological results, or shows the presence of coliform, then the line shall be re-chlorinated, flushed, and retested until satisfactory results are obtained at the expense to CONTRACTOR.

- END OF SECTION -

**SECTION 43 42 22**  
**BLADDER STYLE SURGE TANK**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. The work described by this section of specifications consists of furnishing all equipment, materials, and labor to provide, install, and test two (2) vertical bladder-type surge tanks to minimize hydraulic transient pressures from shock waves due to pump start-up, shutdown or valve closure for the potable water pump station as shown in the Contract Drawings and specified in the Contract Documents.
- B. The Work included in this section consists of the furnishing of a complete surge control system and system's appurtenances for the surge protection of a pump station to prevent fluid column separation and/or to limit pressure transients in the pipeline system following pump start-up, pump shutdown (including a power failure situation), or valve closure. The pressure transients in the pipeline system following the conditions described above, must not exceed the pressure rating of the pipeline plus surge allowance for the type of pipeline at any point in the pipeline system.
- C. Unit Responsibility - The complete surge control system shall be designed and supplied by a single manufacturer. However, this shall not relieve CONTRACTOR's responsibility for coordinating, installing, and performing their complete portion of the Work.

**1.2 RELATED WORK**

- A. Related Work specified in other Sections includes, but is not limited to:
  - 1. Section 01 33 00 Submittal Procedures
  - 2. Section 09 90 00 Painting and Finishes
  - 3. Section 40 05 13.13 Steel Process Piping

**1.3 REFERENCES**

- A. The latest edition of the following publications forms a part of these Specifications to the extent referenced. The publications are referred to in the text by basic designation only.
- B. CODES
  - 1. The building code referenced herein shall be the International Building Code (IBC) as defined in Section 01 42 19 entitled "Reference Standards".
  - 2. ASME Boiler and Pressure Vessel Code.
  - 3. American Welding Society (AWS) Fabrication Code.
  - 4. ASME Fabrication Code
  - 5. National Board Inspection Code (NBIC)
  - 6. NEMA Industrial Control Systems Code
- C. COMMERCIAL STANDARDS
  - 1. ANSI B 16.3-85 Malleable iron threaded fittings Class 150 and 300
  - 2. ANSI B 16.9-86 Factory-made wrought steel butt welding fittings

- |                  |   |
|------------------|---|
| 3. ASTM A 36     | Rolled structural steel bars, plates, shapes, and sheet piling.   |
| 4. ASTM A 53-87  | Pipe, steel, black and hot-dipped, zinc-coated welded and seamless  |
| 5. ASTM A 47-84  | Malleable iron castings   |
| 6. ASTM A 197-87 | Cupola malleable iron   |
| 7. ASTM A 234-87 | Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures                              |
| 8. ASTM A 285    | Pressure vessel plates, carbon steel, low- and intermediate- tensile strength intended for fusion-welded pressure vessels |
| 9. NEMA ICS 6    | Enclosure   |
| 10. SSPC-SP5     | Shop blast surface preparation - White Metal Blasting Cleaning  |
| 11. SSPC-SP6     | Shop blast surface preparation - Commercial Blast Cleaning  |
| 12. SSPC-SP10    | Shop blast surface preparation - Near White Metal Blast Cleaning  |

#### **1.4 SUBMITTALS**

A. The following shall be submitted in accordance with Section 01 33 00 - Submittal Procedures:

1. Complete dimensional fabrication drawings of the surge tank and include the dimensions of all equipment, accessories, supports, connections, outlets, and all related piping.
2. Catalog cut sheets for all accessories and piping.
3. Tank NSF 61 certification.
4. Equipment weights and anchor bolt designs.
5. Stamped calculations prepared by a professional engineer (registered in the State of Utah) for approval before tank fabrication.
6. Immediately following fabrication, and before tank shipment, provide a Certification of ASME Code stamp. This document shall be signed by the Fabricator and shall bear a notary stamp for the state in which fabrication takes place and shall indicate that the code stamp has been obtained for the tank to be supplied.
7. The Surge Tank Supplier shall indicate the Gas-to-Fluid ratio (or percent of fluid in the tank), based on recommendations of the Hydraulic Transient Analysis.

#### **1.5 QUALITY ASSURANCE**

A. This Specification has been constructed around a vertical bladder-type vessel as manufactured by Charlotte of America. Any related construction and/or design modifications necessitated due to the use of an alternate tank design shall be the responsibility of CONTRACTOR.

B. The Tank Supplier must have a minimum of five years of design and manufacturing experience and must submit a Hydraulic Transient Analysis for the Engineer's approval (or verify analysis performed by others) showing: input data for the piping system, steady state flow rate and pressure head, initial and maximum expanded gas volume, and envelope of maximum and minimum line pressure throughout the pipeline system. In addition, a predicted pressure-time history at the pump station and at other critical points in the pipeline system will also be required.

C. The manufacturer shall be ISO-9001 certified which includes engineering, design, manufacturing and testing complete components. Vessel manufacturer shall manufacture their own vessels and bladders within the same plant as per quality control



through ISO.

- D. Manufacturer shall provide inhouse x-rays of welds if required by ASME code, hydrostatic test, and ASME inspection. ENGINEER reserves the right to inspect the vessel manufacturing facility to confirm requirement above.

## 1.6 WARRANTY

- A. The surge control system and instrumentation shall carry a warranty of one year from initial operation or eighteen months from delivery, whichever comes first.

## PART 2 PRODUCTS

### 2.1 GENERAL

- A. The vertical bladder-type surge tank shall be provided with the manufacturer's services at the jobsite at no additional cost to OWNER. One full 4-hour day of service from manufacturer's representative shall be provided per tank to approve the tank installation and advise CONTRACTOR during startup, testing, and final adjustment of each tank. In addition to this day, one additional full 8-hour day shall be provided in a separate trip to instruct OWNER's personnel in the operation and maintenance of the tank system.

### 2.2 SURGE TANK

- A. The tank shall be a vertical, bladder-type vessel suitable for use with potable water. Tank shall be a **132 gallon (500 Liter)**, bladder type vertical surge tank as manufactured by **HCA-1000-10/15-V Charlotte, Young Engineering and Manufacturing, Inc.**, or approved equal.
- B. For the surge protection purposes, the criteria and data shown in the schedule shall be used for designing and sizing the surge control tanks. Tanks shall be cylindrical with elliptical (or similar) heads.

**SURGE TANK SCHEDULE**

ITEM	ST-1	ST-2
Volume (min)	17.7 Cubic Feet (132 Gallons, 500 Liters)	17.7 Cubic Feet (132 Gallons, 500 Liters)
Nominal Diameter	2.00 Feet	2.00 Feet
Configuration	Vertical	Vertical
Approx. Height	6.3 Feet	6.3 Feet
Precharge Pressure	17 psig	66.5 psig
Design Pressure	150 psig	155 psig
Design Test Pressure	200 psig	200 psig
Inlet Diameter	10 Inches	10 Inches

- C. Structural Design and Supports shall include the tank, supports, and anchor bolts shall

be designed based upon local building codes in addition to the following criteria:

1. Design for a hydrostatic operating pressure of 160 psi and a test pressure of 200 psi with no reactive load permitted through the inlet/outlet piping.
2. Support tank by support legs (four minimum) for attaching to a concrete floor slab. Material of construction shall comply with ASTM A 36 or ASTM A 285, Grade C. Weld the support legs to the tank.
3. Connection to floor piping per Contract Drawings.
4. Seismic Design Parameters to conform to the current IBC (if necessary and required by design engineer).

#### D. Surge Tank Design and Materials

1. Materials for the tank, design, and shop fabrication and inspection shall comply with Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code with only the plate steels in Table UCS-23 of said code being used. Provide ASME code stamp, National Board Registration number and pressure rating on tank.
  - a. The bladder surge tank shall be designed to withstand a full vacuum service conditions without damage to the steel shell or a bladder.
2. Minimum design pressure shall be as stated in this section of the Specifications. Perform hydrostatic testing in shop. Test pressure shall be 150% of the design pressure of the tank.
3. The surge tank, the bladder, coating, and lining shall be NSF 61 approved, and listed on the NSF database, for use with potable water applications. Proof of NSF listing of the entire tank model shall be submitted to ENGINEER.
4. Complete anchor bolt assembly (studs, nuts, washers, etc.) to be provided by CONTRACTOR.
5. Bladders and replacement bladders shall be manufactured in the Surge Tank Suppliers' plant. Tanks/Vessels shall be fabricated by listed manufacturer, not contracted out.
6. Provide a threaded connection at the top of the tank to contain a gas charging valve and pressure gauge. Tank shell will be constructed of deep drawn carbon steel double sub-arc welded domes and side shells with double welded seams. Tank shall be equipped with a food grade, heavy duty butyl rubber bladder. The precharge pressure will be located between the shell of the tank and the bladder. The top accessway shall be removable to allow inspection and maintenance of the bladder. The bladder shall be sized to conform to the inner shape of the vessel. Bladder tank shall be of the vertical configuration.
7. Bladder tank shall conform with NBIC.

#### E. Service Conditions

1. The manufacturer shall review the plans and specifications and the surge analysis as performed by ENGINEER in regard to the system hydraulics and the surge vessel. If the Surge Tank Supplier's hydraulic analysis of the system yields varying design requirements, ENGINEER should be contacted.

#### F. Valves

1. The tank shall be designed to function properly with the specific valves, including but not limited to plug valves and check valves, submitted by CONTRACTOR. Acceptance of these valves shall be clearly stated in the surge tank submittal.
2. Safety (Pressure Relief) Valve: The valve shall have a stainless-steel body and bonnet and shall have stainless steel trim. Pressure relief valves shall be certified to ASME Section VIII, GENERAL REQUIREMENTS, UG-125, AND 126. Set at 450 psig. Valves shall be **Apollo Series 500**, or approved equal.

#### G. Level monitoring

1. General: Provide tank monitoring equipment per the Surge Tank Supplier's standards with 4-20mA output signals.
2. Pressure differential transmitter shall be **Rosemount Model 3051 digital pressure transmitter** or approved equal.
  - b. Transmitter shall be two-wire, capacitance (DP/GP) or piezoresistive (AP/GP), high performance differential/gage/absolute/level/flow pressure transmitter.
  - c. Pressure transmitter shall be NEC 501-5, NEMA code ICS6 and FM certified and have 4-20 mA output signal.
  - d. Pressure differential transmitter shall be hard mounted on the tank via a 2-inch 150 lbs flange.
3. Magnetic Level Gauge
  - e. The Surge Tank shall be equipped with a magnetic level gauge.

#### H. Painting and Coating

1. All coating and lining shall be completed at the factory per Section 09 90 00 – Painting and Finishes.

### PART 3 EXECUTION

#### 3.1 TESTING

##### A. FABRICATION TEST

1. The Surge Tank shall be shop tested hydrostatically to a pressure of 1.5 times the design pressure for a period of not less than 24 hours. All leaks shall be detected and immediately repaired prior to painting.

##### B. FIELD STATIC TEST

1. The Surge Tank and system piping shall be hydrostatically tested to the design pressure immediately following installation and before any dynamic testing. The test period shall be four hours minimum, and all leaks detected shall be immediately repaired. Finish touchup painting shall be provided as necessary.

##### C. FUNCTIONAL TEST

1. The surge tank manufacturer shall verify the performance of the surge protection equipment provided by recording surge pressures following a pump trip and summarize the results in a written document. During the required field visit, at least

one pump trip will be required to provide field data needed for the surge model calibration. Field data will be provided to ENGINEER to develop and evaluate the surge computer model. The surge tank vendor shall provide all equipment needed to record the field data during a pump trip. The pressure shall be recorded with a pressure transducer capable of recording the surge pressures at a sample rate of 100 recordings per second. The manufacturer shall provide temporary transducers and software for use during testing.

2. CONTRACTOR shall provide to ENGINEER a complete report of each test performed within ten days after test completion. Reports shall include:
  - a. Date and time of all testing.
  - b. Description of method of testing including pumping combinations, pressure records, etc.
  - c. Description of all observed leaks and method and date of repair. Description of any catastrophic failures.
  - d. Certification that necessary repairs have been made.
  - e. Signature of CONTRACTOR and Manufacturer's representative.

### **3.2 TANK INSTALLATION**

- A. The tank shall be installed in accordance with the manufacturer's suggested procedures. All supports, piping, valves, and related appurtenances shall be provided and installed by CONTRACTOR at no additional cost to OWNER.

- END OF SECTION -

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# **PART 6**

## **APPENDIX**

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