



CONTRACT DOCUMENTS

FOR

MCCORMICK WOODS - WELL NO. 11
SITE IMPROVEMENT PROJECT

June 2023



SECTION 00 01 07 - SEALS PAGE
FOR
MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT
FOR
CITY OF PORT ORCHARD

See Table of Contents for author of each specification section, identified by author's initials as follows:

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MCCORMICK WOODS – WELL NO. 11 SITE IMPROVEMENT PROJECT
FOR
CITY OF PORT ORCHARD**

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END OF SECTION

BIDDING DOCUMENTS

ADVERTISEMENT FOR BIDS
MCCORMICK WOODS – WELL NO. 11 SITE IMPROVEMENT PROJECT
PUBLIC WORKS PROJECT NO. PW2023-010

Notice is hereby given that sealed bids will be received at the office of the City Clerk for the City of Port Orchard, 216 Prospect Street, Port Orchard, WA 98366 until 10:30 AM on Tuesday July 18, 2023, for construction of the **McCormick Woods – Well No. 11 Site Improvement Project**, Public Works Project No. 023-010. No proposals will be accepted after the above-stated time. Immediately following the above-stated time, the proposals will be publicly opened and read.

The project consists of work to be performed within **350** working days from notice to proceed, and consists of furnishing all materials, equipment, tools, labor, and other work or items incidental theretofore and as generally described as follows:

Various site improvements to the well field of the McCormick Woods water system, a public water system that currently consists of four wells designated Well 1, Well 2, Well 3, and McCormick Woods Well 11. Work includes, but is not limited to, the following:

- Installation of a 1,250-gpm submersible pump with variable frequency drive at Well 11. Decommissioning of Wells 1 and 2 and conversion of Well 3 to a monitoring well;
- Installation of a 1,250-gpm booster pumping system;
- Demolition of an existing booster pump station and construction of a new approximately 3,000 square-foot booster pump and treatment CMU building;
- Installation of a sodium hypochlorite disinfection system and a sodium fluoride fluoridation system;
- Conversion of two existing 60,000-gallon storage tanks to contact clearwells including cleaning, coating, and equipment replacement;
- Yard piping modifications;
- Site clearing, grading, and paving;
- Electrical and controls work.

A complete statement of work is set out in the bidding information (plans, specifications, addenda, and Bidders List), available through City of Port Orchard's on-line plan room <https://portorchardwa.gov/bids-and-proposals/>

The Engineer's construction estimate for this project is **\$6,140,000**.

This project is partially funded through the Washington State Drinking Water State Revolving Fund (DWSRF) program with federal funds from the Environmental Protection Agency.

General contractors and all subcontractors must meet DWSRF requirements or provisions. The contractor shall ensure knowledge of and compliance with all applicable federal, state, and local laws, requirements, and ordinances as they pertain to the design, implementation, and administration of the approved project.

Free-of-charge access is provided to Prime Bidders, Subcontractors, and Vendors by going to www.bxwa.com and clicking on “Posted Projects,” “Public Works,” and “City of Port Orchard.” This on-line plan room provides Bidders with fully usable online documents with the ability to: download, view, print, order full/partial plan sets from numerous reprographic sources, and a free online digitizer/take-off tool. It is recommended that Bidders “Register” in order to receive automatic email notification of future addenda and to place themselves on the “Self-Registered Bidders List.” Bidders that do not register will not be automatically notified of addenda and will need to periodically check the on-line plan room for addenda issued on this project. Contact Builders Exchange of Washington at 425-258-1303 should you require assistance.

If you do not have access to the Web, you may make arrangements to pick up a plan set at the Port Orchard City Hall, City Clerk’s Office, 216 Prospect Street, Port Orchard, WA 98366, 360-876-4407, for a NON-REFUNDABLE fee of \$100.00. If you wish the bid documents mailed to you, add \$25.00 to cover postage. Informational copies of any available maps, plans, specifications, and subsurface information are on file for inspection in the office of the Port Orchard Project Engineer, 216 Prospect Street, Port Orchard, WA 98366.

All bid proposals shall be accompanied by a bid security (bid deposit) in the form of a cash deposit, certified or cashier’s check, postal money order, or surety bond made payable to the City of Port Orchard, for a sum not less than five percent (5%) of the amount of such bid, including sales tax. Should the successful bidder fail to enter into such contract and furnish satisfactory payment and performance bonds within the time stated in the Specifications, the bid security (bid deposit/bond) shall be forfeited to the City of Port Orchard.

The award of the Contract will go to the qualified bidder submitting the lowest responsible and responsive bid. The City reserves the right to reject any and all bids or waive any informality or irregularity in the bidding and make the award as deemed to be in the best interest of the City and the public.

The City of Port Orchard in accordance with Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d; Section 504 of the Rehabilitation Act of 1973, 29 U.S.C. § 794; The Age Discrimination Act of 1975, 42 U.S.C. § 6102; and Equal Employment Opportunity, Executive Order No. 11246 (1965), hereby notifies all bidders that it will affirmatively insure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color or national origin in consideration for an award.

The City is an equal opportunity and affirmative action employer. Small and Minority-owned businesses, women-owned businesses, and labor surplus area firms are encouraged to submit bids.

Notice is given to all potential bidders that any bid responses may be subject to release under the Public Records Act Chapter 42.56 RCW and the City may be required to disclose bid responses upon a request. Bidders are advised to mark any records believed to be trade secrets or

confidential in nature as “confidential.” If records marked as “confidential” are found to be responsive to the request for records, the City may elect to give notice to the bidder of the request so as to allow the bidder to seek a protective order from a Court. Please be advised, however, that any records deemed responsive to a public records request may be released at the sole discretion of, and without notice by, the City.

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**NOTICE TO PROSPECTIVE BIDDERS
MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT**

In accordance with Section 1-02.4(1) of the Standard Specifications, it is the City of Port Orchard's policy that questions concerning the project during the bidding process be submitted in written form. Please submit any questions that are pertinent to bidding the contract, and that are not answered by information contained in the Contract Documents, to the City of Port Orchard Engineering Department via email at publicworks@portorchardwa.gov, Attention: Tony Lang.

All emails must be received at least 3 business days prior to the bid opening for a response. All prospective bidder questions and the City's response will be sent via email, if possible, to all prospective bidders who have purchased plans approximately 2 days prior to the bid opening.

If you believe the Contract Documents contain an error or error(s), please provide us with that information via email. An addendum will be issued to all prospective bidders if a correction is needed.

I have the following question(s)/comment(s):

I believe the Contract Document(s) has (have) the following error(s):

Please respond to:

Name: _____

Representing: _____

Address: _____

Email address: _____

Fax Number: _____

INFORMATION AND CHECKLIST FOR BIDDERS

The following supplements the information in the Advertisement for Bids:

1. Pre-Bid Conference

June 29, 2023 at 10:00 am

2. Examination of Plans, Specifications, and Site

Before submitting their bid, the Contractor shall carefully examine each component of the Bid Documents and any other available supporting data so as to be thoroughly familiar with all the requirements.

The Bidder shall make an alert, heads-up, eyes-open reasonable examination of the project site and conditions under which the Work is to be performed, including but not limited to: current site topography, soil and moisture conditions; underground obstructions; the obstacles and character of materials which may be encountered; traffic conditions; public and private utilities; the availability and cost of labor; and available facilities for transportation, handling and storage of materials and equipment.

3. Property Issues

All bidders shall base their bids upon full restoration of all property within the right-of-way and easements, and wherever Bidder will have right-of-entry. The easements and right of entry documents that have been acquired are available for inspection and review. The Bidder is advised to review the conditions of the permits, easements, and rights-of-entry, as they shall be required to comply with all conditions at no additional cost to the Owner. All other permits, licenses, etc., shall be the responsibility of the Bidder. The Bidder shall comply with the requirements of each.

4. Interpretation of Bid Documents

The Bidder shall promptly notify Owner of any discovered conflicts, ambiguities, or discrepancies in or between, or omissions from the Bid Documents. Questions or comments about these Bid Documents should be directed to the attention of: Tony Lang, Public Works Director/City Engineer, and sent via email to publicworks@portorchardwa.gov or mail/drop off to 216 Prospect Street, Port Orchard, WA 98366. Questions received less than 3 days prior to the date of bid opening may not be answered. Any interpretation or correction of the Bid Documents will be made only by addendum, and a copy of such addendum will be distributed through plan holders lists at Builders Exchange www.bxwa.com, the City's Website <https://portorchardwa.gov/bids-and-proposals/> and the City Clerk's Plan holders list. The Owner will not be responsible for any other explanations or interpretations of the Bid

Documents. No oral interpretations of any provision in the Bid Documents will be made to any Bidder.

5. Bidding Checklist

All bids shall be submitted on the exact forms provided in these Bid Documents, and listed below. Failure to submit any of these forms may be grounds for rejection of the bid. Sealed bids for this proposal shall be submitted as specified in the Advertisement for Bids. Each bid must be submitted in a sealed envelope bearing on the outside the name and address of the Bidder, and the name and number of the project for which the bid is submitted. All bids will remain subject to acceptance for sixty (60) calendar days after the day of the bid opening.

- A. **Proposal** – Bidders must bid on all items contained in the Proposal. If any unit price is left blank, it will be considered no charge for that bid item, regardless of what has been placed in the extension column.
- B. **Bid Security** – Bid Bond is to be executed by the Bidder and the surety company unless bid is accompanied by a cash deposit, cashier's or certified check, or postal money order. The amount of this bond shall be not less than five percent (5%) of the total bid, including sales tax, if applicable, and may be shown in dollars. Surety must be authorized to do business in the State of Washington, and must be on the current Authorized Insurance List in the State of Washington per Section 1-02.7 of the Standard Specifications.
 - i. The bond form included in these Contract Provisions MUST be used; no substitute will be accepted. If an attorney-in-fact signs the bond, a certified and effectively dated copy of their Power of Attorney must accompany the bond.
 - ii. The bid bond/deposit of the successful Bidder will be returned provided they execute the Contract, furnishes satisfactory performance bond covering the full amount of work, provides evidence of insurance coverage, and other documents required by the contract documents within 14 calendar days after Notice of Award. Should they fail or refuse to do so, the Bid Deposit or Bond shall be forfeited to the City of Port Orchard as liquidated damages for such failure.
 - iii. The Owner reserves the right to retain the security of the three lowest bidders until the successful Bidder has executed the Contract and furnished the performance bond.
- C. **Non-Collusion Declaration** – DOT Form 272-036H EF included in these Contract Provisions must be returned with the bid proposal.
- D. **Bidder's Qualification Form** – Regarding forms D and E, the Owner reserves the right to check all statements and to judge the adequacy of the Bidders qualifications.
- E. **DBE Utilization Certification Form** – Must be filled in and Signed.
- F. **Certification of Compliance with Wage Payment Statutes** – Must be filled in and signed.

G. **Supplemental Criteria Information Form** - Must be filled in and signed.

H. - **Subcontractors List** – Must be completed.

6. **Contract Checklist**

The following forms are to be executed by the successful Bidder after the Contract is awarded. The Contract and Performance and Payment Bond are included in these Bid Documents and should be carefully examined by the Bidder.

- A. **Contract** – Two copies to be executed by the successful Bidder. Bid and Contract Documents must be executed by the Contractor’s President or Vice-President if a corporation, or by a partner if a partnership. In the event another person has been duly authorized to execute contracts, a copy of the resolution or other minutes establishing this authority must be attached to the Proposal and Contract documents.
- B. **Performance/Payment Bond and Warranty Bond** – One copy of each type of bond to be executed by the successful Bidder and his surety company. These bonds cover successful completion of all work and payment of all laborers, subcontractors, suppliers, etc. and provide a warranty for the contract work. The bond forms included in these Bid Documents **MUST** be used; no substitutes will be accepted. If an Attorney-in-fact signs the bond(s), a certified and effectively dated copy of their Power of Attorney must accompany the bond(s).
- C. **Certificates of Insurance** – To be executed by an insurance company acceptable to the Owner, on ACCORD Forms. Required coverages are listed in Section 1-07.18 of the Standard Specifications, as may be modified by the Special Provisions. The Owner shall be named as “Additional Insured” on the insurance policies.
- D. **Selection of Retainage Option** – Pursuant to RCW 60.28.010, 5% retainage will be retained until fulfillment of state and local compliance is documented. The retainage form should be completed by the successful bidder.
- E. **Prevailing Wage Requirements** –

The Contractor is required to pay, at a minimum, the applicable prevailing wage rates to those employees performing services under the Contract. The applicable wage rates are set forth in the State of Washington Department of Labor and Industries Prevailing Wage Rate Schedule, RCW 39.12.020 and Federal Wage Rates in accordance with the Davis-Bacon Act. Refer to the DWSRF Borrowers Handbook included in the appendices.

The project site is located in **Kitsap County**.

The prevailing wage schedule in effect for the work under the Contract will be the one in effect upon the prime contractor’s bid due date with these exceptions:

- If the project is not awarded within six (6) months of the bid due date, the award date (the date the contract is executed) is the effective date.
- If the project is not awarded pursuant to bids, the award date (the date the contract is executed) is the effective date.
- Janitorial contracts follow WAC 296-127-023.

For Public Work Project No. PW2023-010 the prime contractor bid due date is **July 18, 2023**.

Except for janitorial contracts, the rates in effect on the bid due date shall apply for the duration of the contract (unless otherwise noted in the solicitation).

It is the responsibility of the Contractor to ensure the appropriate labor classification(s) are identified and that the applicable wage and benefit rates are taken into consideration when preparing their proposal according to these specifications.

The selected Contractor must submit to the Department of Labor and Industries, a "Statement of Intent to Pay Prevailing Wages". A copy of the certified Intent Statement must be submitted to the City prior to payment of the first invoice. The Contractor will pay promptly, when due, all wages accruing to its employees. www.lni.wa.gov/licensing-permits/public-works-projects/contractors-employers/#required-documents-for-doing-the-work

All invoice or payment applications are required to bear the following signed statement: "I certify that wages paid under this contract are equal to or greater than the applicable wage rates set forth in the Washington State Prevailing Wage Rates for Public Works Contracts issued by the State of Washington Department of Labor and Industries."

The selected Contractor must submit to the Department of Labor and Industries an "Affidavit of Wages Paid" and a copy of an approved Affidavit must be submitted at the end of the contract to the City before the last payment or any retained funds will be released. www.lni.wa.gov/licensing-permits/public-works-projects/contractors-employers/#when-the-work-is-done

The cost of filing a Statement of Intent to Pay Prevailing Wages and Affidavit of Wages Paid with the Department of Labor and Industries shall be at no additional cost to the City.

The Director of the Department of Labor and Industries shall arbitrate all disputes of the prevailing wage rate, RCW 39.12.060 and WAC 296-127-060.

Look up the prevailing rates of pay, benefit, and overtime codes from this link: <http://www.lni.wa.gov/TradesLicensing/PrevWage/WageRates/default.asp> A copy of the prevailing wage rates is available for viewing at the City of Port Orchard Department of Public Works. A hard copy will be mailed upon request.

For prevailing wage questions, contact the Department of Labor & Industries at PW1@Lni.wa.gov or 360-902-5335.

7. Contractor Disqualification

A bidder will be deemed not responsible and the proposal rejected if the bidder does not meet the following responsibility criteria set forth in RCW 39.04.350, which provides, in part, as follows:

(1) Before award of a public works contract, a bidder must meet the following responsibility criteria to be considered a responsible bidder and qualified to be awarded a public works project. The bidder must:

(a) At the time of bid submittal, have a certificate of registration in compliance with chapter 18.27 RCW;

(b) Have a current state unified business identifier number;

(c) If applicable, have industrial insurance coverage for the bidder's employees working in Washington as required in Title 51 RCW; an employment security department number as required in Title 50 RCW; and a state excise tax registration number as required in Title 82 RCW;

(d) Not be disqualified from bidding on any public works contract under [RCW 39.06.010](#) or [39.12.065\(3\)](#);

(e) If bidding on a public works project subject to the apprenticeship utilization requirements in [RCW 39.04.320](#), not have been found out of compliance by the Washington state apprenticeship and training council for working apprentices out of ratio, without appropriate supervision, or outside their approved work processes as outlined in their standards of apprenticeship under chapter 49.04 RCW for the one-year period immediately preceding the date of the bid solicitation;

(f) Have received training on the requirements related to public works and prevailing wage under this chapter and chapter 39.12 RCW. The bidder must designate a person or persons to be trained on these requirements. The training must be provided by the department of labor and industries or by a training provider whose curriculum is approved by the department. The department, in consultation with the prevailing wage advisory committee, must determine the length of the training. Bidders that have completed three or more public works projects and have had a valid business license in Washington for three or more years are exempt from this subsection. The department of labor and industries must keep records of entities that have satisfied the training requirement or are exempt and make the records available on its web site. Responsible parties may rely on the records made available by the department regarding satisfaction of the training requirement or exemption.

(g) Within the three-year period immediately preceding the date of the bid solicitation, not have been determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction to have willfully violated, as defined in [RCW 49.48.082](#), any provision of chapter 49.46, 49.48, or 49.52 RCW.

(h) The bidder shall not be listed as a current debarred or suspended bidder on the Federal “System For Award Management” website www.sam.gov.

The Bidder shall submit a signed statement to the City in accordance with Chapter 5.50 RCW verifying under penalty of perjury that (1) the bidder is in compliance with the responsible bidder criteria in subsection (1)(g) above; and (2) that the Contractor is not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded by any Federal department or agency in accordance with Executive Orders 12549 and 12689, 24 C.F.R. Pt. 24.

2) A bidder may be deemed not responsible and the proposal rejected if:

- a. More than one proposal is submitted for the same project from a bidder under the same or different names;
- b. Evidence of collusion exists with any other bidder or potential bidder. Participants in collusion will be restricted from submitting further bids;
- c. The bidder, in the opinion of the Contracting Agency, is not qualified for the work or to the full extent of the bid, or to the extent that the bid exceeds the authorized prequalification amount as may have been determined by a prequalification of the bidder;
- d. An unsatisfactory performance record exists based on past or current Contracting Agency work or for work done for others, as judged from the standpoint of conduct of the work; workmanship; progress; affirmative action; equal employment opportunity practices; or Disadvantaged Business Enterprise, Minority Business Enterprise, or Women’s Business Enterprise utilization;
- e. There is uncompleted work (Contracting Agency or otherwise) which might hinder or prevent the prompt completion of the work bid upon;
- f. The bidder failed to settle bills for labor or materials on past or current contracts;
- g. The bidder has failed to complete a written public contract or has been convicted of a crime arising from a previous public contract;
- h. The bidder is unable, financially or otherwise, to perform the work; or
- i. There are any other reasons deemed proper by the Contracting Agency.



**STATEMENT OF INTENT TO
 PAY PREVAILING WAGES**
Public Works Contract
\$40.00 Filing Fee Required

Intent ID # (Assigned by L&I) _____

- This form must be typed or printed in ink.
- Fill in all blanks or form will be returned for correction (see back).
- Please allow a minimum of 10 working days for processing.
- Once approved, your form will be posted online at the website above.

APPROVED FORM WILL BE MAILED TO THIS ADDRESS
 Contractor, company or agency name, address, city, state & ZIP+4

Project Name		Contract Number	
Contract Awarding Agency (public agency - not federal or private)			
Awarding Agency Address			
City		State	ZIP+4
Awarding Agency Project Contact Person		Phone Number	
County where work will be performed		City where work will be performed	
Bid due date (mm/dd/yy)		Date contract awarded (mm/dd/yy)	
Prime Contractor (has contract with the public agency)		Prime's Phone Number	
Prime's Contractor Registration Number		Prime's UBI Number	
Number of Owner/Operators that own at least 30% of the company who will perform work on the project:		Expected job start date (mm/dd/yy)	
Will employees perform work on this project? <input type="checkbox"/> Yes <input type="checkbox"/> No If "Yes", please list worker's craft/trade/occupation below. (If you choose "No" and this changes later, you certify that you will submit a new form listing workers.)		Do you intend to use subcontractors? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Do you intend to use apprentice employees? <input type="checkbox"/> Yes <input type="checkbox"/> No		Responding "Yes" to either of the questions above will then require you to list the subcontractor, their UBI #, and Contractor Registration # (if they are required to have one) on Addendum B of the Affidavit of Wages Paid form.	

Craft/trade/occupation. (Do NOT list apprentices.) When using employees in more than one craft, each craft transition must be accurately recorded on the time sheet.	Estimated number of workers	Rate of hourly pay	Rate of hourly fringe benefits

Sample

Company Name	
Address	
City	State ZIP+4
Contractor Registration Number	UBI Number
Industrial Insurance Account Number	
Email Address	Phone Number
For L&I Use Only	
APPROVED:	Department of Labor and Industries
By _____	Industrial Statistician

Indicate total dollar amount of your contract (including Sales Tax) or time and materials, if applicable.	\$ _____
I hereby certify that the information, including any addendums, is correct and that all workers I employ on this Public Works Project will be paid no less than the Prevailing Wage Rate(s) as determined by the Industrial Statistician of the Department of Labor and Industries.	
Title	Signature

For L&I Use Only	
Check Number: _____	<input type="checkbox"/> \$40 or \$ _____
Issued By: _____	

F700-029-000 statement of intent to pay prevailing wages 05-08

DO NOT SEPARATE FORMS PRIOR TO APPROVAL BY L&I
 (White & canary copies must be submitted-canary will be retained by L&I after approval.)



AFFIDAVIT OF WAGES PAID
Public Works Contract
\$40.00 Filing Fee Required

Affidavit ID # (Assigned by L&I) _____

- This form must be typed or printed in ink.
- Fill in all blanks or form will be returned for correction (see back).
- Please allow a minimum of 10 working days for processing.
- Once approved, your form will be posted online at the website above.

APPROVED FORM WILL BE MAILED TO THIS ADDRESS
 Contractor, company or agency name, address, city, state & ZIP+4

Project Name		Contract Number	
Contract Awarding Agency (public agency - not federal or private)			
Awarding Agency Address			
City		State	ZIP+4
Awarding Agency Project Contact Person		Phone Number	
County where work was performed		City where work was performed	
Bid due date (mm/dd/yy)		Date contract awarded (mm/dd/yy)	
Date work completed (mm/dd/yy)		Date Intent filed (mm/dd/yy)	
Prime Contractor (has contract with the public agency)		Prime's Phone Number	
Prime's Contractor Registration Number		Prime's UBI Number	
Number of Owner/Operators that own at least 30% of the company who will perform work on the project:		Intent ID #	
Did Employees Perform Work on this Project? <input type="checkbox"/> Yes <input type="checkbox"/> No If "Yes", please list worker's craft/trade/occupation below.		Was all work subcontracted? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Did Employees Perform Work on this Project? <input type="checkbox"/> Yes <input type="checkbox"/> No If "Yes", please list worker's craft/trade/occupation below.		Did you use subcontractors? <input type="checkbox"/> Yes <input type="checkbox"/> No	
Responding "Yes" to either of the above questions will require that you fill out Addendum B, List of Next Tier Subcontractors.			
Job start date (mm/dd/yy)			

Craft/trade/occupation and apprentices. (For apprentices, give name, registration #, trade, dates of work on project, stage of progression, wage and fringe.)	Number of workers	Total # of hours worked - ea. trade	Rate of hourly pay	Rate of hourly fringe benefits

Sample

Company Name	
Address	
City	State ZIP+4
Contractor Registration Number	UBI Number
Industrial Insurance Account Number	
Email address	Phone Number
For L&I Use Only	
APPROVED: Department of Labor and Industries	
By _____	Industrial Statistician

Indicate total dollar amount of your contract (including Sales Tax.)	\$ _____
I hereby certify that the information, including any addendums, is correct and that all workers I employed on this Public Works Project were paid no less than the Prevailing Wage Rate(s) as determined by the Industrial Statistician of the Department of Labor and Industries.	
Title	Signature

For L&I Use Only	
Check Number:	<input type="checkbox"/> \$40 or \$ _____
Issued By:	_____

F700-007-000 affidavit of wages 05-08 DO NOT SEPARATE FORMS PRIOR TO APPROVAL BY L&I
 (White & canary copies must be submitted-canary will be retained by L&I after approval.)

PROPOSAL

**CITY OF PORT ORCHARD
MCCORMICK WOODS – WELL NO. 11 SITE IMPROVEMENT PROJECT
PUBLIC WORKS PROJECT NO. PW2023-010**

To: Mayor and City Council
City of Port Orchard, Washington

Contractor: _____
State License No.: _____

Date: _____
Month/Day/Year

Bidder’s Declaration and Understanding

The Bidder declares that they have carefully examined the Contract Documents for the construction of the project, that they have personally inspected the site, that they have satisfied themselves as to the quantities involved, including materials and equipment, and conditions of work involved, including the fact that the description of the quantities of work and materials, as included herein, is brief and is intended only to indicate the general nature of the work and to identify the said quantities with the detailed requirements of the Contract Documents, and that this Proposal is made according the provisions and under the terms of the Contract Documents, which Documents are hereby made a part of this Proposal. The Bidder further declares that they have exercised their own judgment regarding the interpretation, of subsurface information and has utilized all data, which they believe pertinent from City and other sources and has made such independent investigations as the Bidder deems necessary in arriving at their conclusions.

Bidder understands that any bid response documents may be subject to release under the Public Records Act Chapter 42.56 RCW and the City may be required to disclose bid responses upon a request. Bidder acknowledges that they been advised to mark any records believed to be trade secrets or confidential in nature as “confidential.” If records marked as “confidential” are found to be responsive to the request for records, the City as a courtesy to the Bidder may elect to give notice to Bidder of the request so as to allow Bidder to seek a protective order from a Court. Bidder acknowledges and agrees that any records deemed responsive to a public records request may be released at the sole discretion of, and without notice by, the City.

Contract Execution

The Bidder agrees that if this Proposal is accepted, they will, within fourteen (14) calendar days after Notice of Award, complete and sign the Contract in the form annexed hereto, and will at that time deliver to the City executed copies of the Performance Bond, Labor and Material Payment bond, the Certificate of Insurance, and other documentation required by the Contract Documents, and will, to the extent of their Proposal, furnish all machinery, tools, apparatus and other means of construction and do the work and furnish all the materials or services necessary to complete all work as specified or indicated in the Contract Documents.

Start of Construction and Contract Completion

The Bidder further agrees that within 14 calendar days of CONTRACT START DATE, they will meet with engineering personnel, and complete the construction within **350** working days of START DATE.

Lump Sum and Unit Price Work

The Bidder further proposes to accept as full payment for the work proposed herein the amounts computed under the provisions of the Contract Documents and based on lump sum and unit price amounts, it being expressly understood that the unit prices are independent of the exact quantities involved. The Bidder agrees that the lump sum prices and the unit prices represent a true measure of the labor, services, and materials required to perform the work, including all allowances for overhead and profit for each type and unit of work called for in these Contract Documents.

If any material, item, or service required by the Contract Documents has not been mentioned specifically, the same shall be furnished and placed with the understanding that the full cost to the City has been merged with prices named in the proposal.

SCHEDULE OF CONTRACT PRICES
MCCORMICK WOODS WELL NO. 11 SITE IMPROVEMENT PROJECT

NOTE: Unit prices for all items and the total amount bid must be shown. The Project must be bid in its entirety, including all bid items as specifically listed in the Proposal, in order to be considered a responsive bid. Where conflict occurs between the unit price and the total amount named for any items, the unit price typed or printed and entered in ink shall prevail. The Contracting Agency reserves the right to award all work bid according to the lowest qualified responsive bid tendered, available funds, and as it best serves the interest of the Contracting Agency. All work awarded will be made to the same Contractor/bidder.

Item No.	Estimated Quantity	Description of Item/ Total Amount in Words	Unit Price	Total Amount
Base Bid				
1	Lump Sum	Mobilization, Bonds, Insurance, and Demobilization	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
2	Lump Sum	Traffic Control	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
3	Lump Sum	Surveying and Construction Staking	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
4	Lump Sum	Erosion and Sedimentation Control	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
5	Lump Sum	Sheeting, Shoring, and Bracing	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
6	80	DI Pipe for Water Main, 8 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	
7	330	DI Pipe for Water Main, 10 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	
8	90	DI Pipe for Water Main, 12 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	
9	80	PVC Pipe for Drain, 4 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	

Item No.	Estimated Quantity	Description of Item/ Total Amount in Words	Unit Price	Total Amount
10	220	PVC Pipe for Drain, 10 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	
11	35	DI Pipe for Storm, 8 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	
12	45	DI Pipe for Storm, 12 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	
13	600	PVC Pipe for Gravity Sewer, 8 In. Diam.	\$ _____	\$ _____
		(Total Amount in Words)	Per Lineal Foot	
14	Lump Sum	Piping, Fittings, Valves, and Appurtenances inside Pump Station Building	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
15	4	48-inch Concrete Manholes	\$ _____	\$ _____
		(Total Amount in Words)	Per Each	
16	1	60-inch Concrete Dechlorination Manhole	\$ _____	\$ _____
		(Total Amount in Words)	Per Each	
17	Lump Sum	Pump Station Building	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
18	1	Well No. 11 Pump	\$ _____	\$ _____
		(Total Amount in Words)	Per Each	
19	2	Booster Pumps	\$ _____	\$ _____
		(Total Amount in Words)	Per Each	
20	Lump Sum	Chlorination System	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
21	Lump Sum	Fluoridation System	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	

Item No.	Estimated Quantity	Description of Item/ Total Amount in Words	Unit Price	Total Amount
22	Lump Sum	Water Sampling Station		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
23	Lump Sum	Electrical and Instrumentation		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
24	Lump Sum	Generator Set		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
25	Lump Sum	Testing, Flushing, and Disinfection of Water Mains		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
26	Lump Sum	Well Decommissioning, Abandoning Existing Pipe, and Site Demolition		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
27	Lump Sum	Clearwell Rehabilitation		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
28	660	Hot Mix Asphalt		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Ton	
29	490	Crushed Surfacing Top Course		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Ton	
30	490	Crushed Surfacing Base Course		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Ton	
31	Lump Sum	Final Site Grading, Surface Restoration, and Site Clean-Up		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	
32	Lump Sum	Bioswale		
		_____	\$ _____	\$ _____
		(Total Amount in Words)	Per Lump Sum	

Item No.	Estimated Quantity	Description of Item/ Total Amount in Words	Unit Price	Total Amount
33	Force Account	Minor Changes		
		(Total Amount in Words)	\$100,000 Per Force Account	\$ 100,000
Total Base Bid				\$
			Tax 9.3%	\$
TOTAL BID				\$

SALES TAX

Retailing/Retail Sales Tax Rule WAC 458-20-170: Washington State Retail sales tax added as percent (%) in addition to contract bid price; sales tax shown as separate line item.

The undersigned Bidder hereby agrees to start construction on this project, if awarded, no later than fourteen (14) calendar days after Notice to Proceed and to complete the project within the time stipulated in the Contract. By signing below, Bidder acknowledges receipt of the following Addenda to the Bid Documents:

**CITY OF PORT ORCHARD
MCCORMICK WOODS – WELL NO. 1 SITE IMPROVEMENT PROJECT
PUBLIC WORKS PROJECT NO. 2023-010**

_____	_____	_____	_____
Addendum No.	Date of Receipt	Addendum No.	Date of Receipt
_____	_____	_____	_____
Addendum No.	Date of Receipt	Addendum No.	Date of Receipt

NOTE: Failure to acknowledge receipt of Addenda may be considered as an irregularity in the Bid Proposal and Owner reserves the right to determine whether the bid will be disqualified.

By signing below, Bidder certifies that they have reviewed the insurance provisions of the Bid Documents and will provide the required coverage.

The undersigned Bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date for this Project, the Bidder is not a “willful” violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

<u>OFFICIAL AUTHORIZED TO SIGN FOR BIDDER:</u>	
“I certify (or declare) under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.”	
Signature:	Date:
Printed Name and Title:	Location or Place Executed (City, State):
Business Address:	Business Telephone:

NOTES: If the Bidder is a co-partnership, give firm name under which business is transacted; proposal must be executed by a partner. If the Bidder is a corporation, proposal must be executed in the corporate name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign).

STATE OF _____)
)ss.

COUNTY OF _____)

I certify that I know or have satisfactory evidence that _____ signed this proposal, on oath stated that they are authorized to execute the proposal and acknowledged it as the _____ (title) of _____ (name of party on behalf of whom proposal was executed) and acknowledged it to be their free and voluntary act for the uses and purposes mentioned in this proposal.

Dated this _____ day of _____, 20____.

Notary Public

Printed Name

My Commission Expires:

BIDDER'S QUALIFICATION FORM

**CITY OF PORT ORCHARD
MCCORMICK WOODS – WELL NO. 11 SITE IMPROVEMENT PROJECT
PUBLIC WORKS PROJECT NO. PW2023-010**

1. Name of Contractor:

Address:

2. Telephone No. (_____) _____ Fax No.: (_____) _____

Email Address: _____

3. Washington State Dept. of Labor and Industries Worker's Compensation Account No.:

4. Washington State Dept. of Licensing Contractor's Registration No.: _____

Expiration Date: _____

5. Washington State Uniform Business Identifier No.: _____
(Must have UBI number before the contract is awarded.)

6. Does the Contractor have a City of Port Orchard Business License Yes: _____ No: _____
(A City of Port Orchard Business license is required prior to commencing work pursuant to a written Notice to Proceed)

7. Number of years engaged in contracting business under above name: _____

8. At the time of bid submittal, did the contractor have a certificate of registration in compliance with Chapter 18.27 RCW? _____

9. Does the contractor have industrial insurance coverage for its employees working in Washington as required in Title 51 RCW? (Provide number): _____

10. Does the contractor have an employment security department number as required in Title 50 RCW? (Provide number): _____

11. Does the contractor have a state excise tax registration number as required in Title 82 RCW? (Provide number): _____

12. Has the contractor been disqualified from bidding on any public works contract under RCW 39.06.010 or 39.12.065(3)? _____

13. If project includes Federal funding. Is the Contractor registered in Sam.gov? Yes ___ No ___
Enter Unique Entity ID No. (UEI) _____

14. Has the contractor received training on the requirements related to public works and prevailing wage under chapters 39.04 and 39.12 RCW, as required in RCW 39.04.350(1)(f)

15. Within the three-year period immediately preceding the date of the bid solicitation, was the contractor (determined by a final and binding citation and notice of assessment issued by the department of labor and industries or through a civil judgment entered by a court of limited or general jurisdiction) to have willfully violated, as defined in [RCW 49.48.082](#), any provision of chapter 49.46, 49.48, or 49.52 RCW? _____

16. Has the contractor violated the “Off-site Prefabricated Non-Standard Project Specific Items” reporting requirements more than one time as determined by the department of labor and industries? _____

17. Particular types of construction performed by your company: _____

18. Gross amount of contracts now on hand: \$ _____

19. List similar recent construction projects that your firm has done in the last 7 years (i.e., water and storm and sanitary sewer main construction, well pump installation, building construction, booster pump installation, electrical, mechanical, HVAC installation, road reconstruction, excavations, extensive dewatering, etc.):

Amount	Type	Owner's Name	Phone
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

20. What is the construction experience of the principal individuals to be assigned to this project?

Name	Title	Years of Construction Experience	Availability
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Pursuant to RCW 39.06.020, the contractor further agrees to verify responsibility criteria for each of its subcontractors and to require each of its subcontractors to both verify responsibility criteria as described herein for its subcontractors and include instant condition for verification requirement.

By: _____
(Authorized Signature)

Title: _____

Date: _____

NOTE: Any bidder having current outstanding litigation with the City will not be considered responsible and will be rejected by the City.

**BID SECURITY
CITY OF PORT ORCHARD
MCCORMICK WOODS – WELL NO. 11 SITE IMPROVEMENT PROJECT
PUBLIC WORKS PROJECT NO. PW2023-010**

Bid Deposit:

The undersigned Principal hereby submits a Bid Deposit with the City of Port Orchard in the form of a cash deposit, certified or cashier's check, or postal money order in the amount of _____ Dollars (\$_____).

Bid Bond:

KNOW ALL MEN BY THESE PRESENTS: That we, _____, as Principal and _____, as Surety, are held firmly bound unto the City of Port Orchard, Washington, as Obligee, in the penal sum of _____ Dollars, for the payment of which the Principal and the Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally by these presents.

The conditions of this obligation are such that if the Obligee shall make any award to the Principal for _____, Port Orchard, Washington, according to the terms of the Proposal or Bid made by the Principal therefore, and the Principal shall duly make and enter into a contract with the Obligee in accordance with the terms of said Proposal or Bid and award and shall give bond for the faithful performance thereof, with Surety or Sureties approved by the Obligee, or if the Principal shall, in case of failure to do so, pay and forfeit to the Obligee the penal amount of the deposit specified in the call for bids, then this obligation shall be null and void; otherwise it shall be and remain in full force and effect and the Surety shall forthwith pay and forfeit to the Obligee, as penalty and liquidated damages, the amount of this Bond.

Signed, Sealed and Dated this _____ day of _____, 20____.

Principal

Surety

Signature of Authorized Official

Signature of Authorized Official

Printed Name and Title

By: _____
Attorney-in-Fact (Attach Power of Attorney)

Name and address of local office of
Agent and/or Surety Company:

Surety companies executing bonds must appear on the current Authorized Insurance List in the State of Washington per Section 1-02.7 of the Standard Specification.

Failure to return this Declaration as part of the bid proposal package will make the bid nonresponsive and ineligible for award.

NON-COLLUSION DECLARATION

I, by signing the proposal, hereby declare, under penalty of perjury under the laws of the United States that the following statements are true and correct:

1. That the undersigned person(s), firm, association or corporation has (have) not, either directly or indirectly, entered into any agreement, participated in any collusion, or otherwise taken any action in restraint of free competitive bidding in connection with the project for which this proposal is submitted.
2. That by signing the signature page of this proposal, I am deemed to have signed and to have agreed to the provisions of this declaration.

NOTICE TO ALL BIDDERS

To report rigging activities call:

1-800-424-9071

The U.S. Department of Transportation (USDOT) operates the above toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m., eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report such activities.

The "hotline" is part of USDOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the USDOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

DOT Form 272-036H EF
Revised 5/06

CERTIFICATION OF COMPLIANCE WITH WAGE PAYMENT STATUTES

The bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date June 15, 2023, the bidder is not a “willful” violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

Bidder’s Business Name

Signature of Authorized Officer/Representative*

Printed Name

Title

Date

City

State

Check One:

Sole Proprietorship Partnership Joint Venture Corporation/LLC

State of Incorporation, or if not a corporation, State where business entity was formed:

If a co-partnership, give firm name under which business is transacted:

**If a corporation or limited liability company, this certificate must be executed in the entity’s name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign). If a co-partnership, this certificate must be executed by a partner.*

SUPPLEMENTAL CRITERIA INFORMATION FORM

As evidence that the Bidder meets the mandatory and supplemental responsibility criteria, the apparent two lowest Bidders must submit to the Owner by 12:00 p.m. (noon) of the second business day following the bid submittal deadline, this Supplemental Criteria Information Form verifying that the Bidder meets the Mandatory Criteria under RCW 39.04.350(1) and the Supplemental Bidder Criteria stated below. The two lowest Bidders shall also submit supporting documentation including but not limited to that detailed below (sufficient in the sole judgment of the Owner) demonstrating compliance with all mandatory and supplemental responsibility criteria. The Owner reserves the right to request such documentation from other Bidders as well, and to request further documentation as needed to assess Bidder responsibility. The Owner also reserves the right to obtain information from third parties and independent sources of information concerning a Bidder's compliance with the mandatory and supplemental criteria, and to use that information in their evaluation. The Owner may (but is not required to) consider mitigating factors in determining whether the Bidder complies with the requirements of the supplemental criteria.

The basis for evaluation of Bidder compliance with these mandatory and supplemental criteria shall include any documents or facts obtained by Owner (whether from the Bidder or third parties) including but not limited to: (i) financial, historical, or operational data from the Bidder; (ii) information obtained directly by the Owner from others for whom the Bidder has worked, or other public agencies or private enterprises; and (iii) any additional information obtained by the Owner which is believed to be relevant to the matter.

If the Owner determines the Bidder does not meet the bidder responsibility criteria and is therefore not a responsible Bidder or the bid is not responsive, the Owner shall notify the Bidder in writing, with the reasons for its determination. If the Bidder disagrees with this determination, it may appeal the determination within two (2) business days of the Owner's determination by presenting its appeal and any additional information to the Owner. The Owner will consider the appeal and any additional information before issuing its final determination. If the final determination affirms that the Bidder is not responsible (or the bid is not responsive), the Owner will not execute a contract with any other Bidder until at least two business days after the Bidder determined to be not responsible (or the bid not responsive) has received the Owner's final determination.

Request to Change Supplemental Bidder Responsibility Criteria Prior to Bid: Bidders with concerns about the relevancy or restrictiveness of the Supplemental Bidder Responsibility Criteria may make or submit requests to the Owner to modify the criteria. Such requests shall be in writing, describe the nature of the concerns, and propose specific modifications to the criteria. Bidders shall submit such requests to the Owner no later than five (5) business days prior to the bid submittal deadline and address the request to the Project Engineer or such other person designated by the Owner in the Bid Documents.

For criteria with check boxes, the bidder will check either "Yes" or "No." For each "Yes" answer on the form, the Bidder shall provide a signed and dated statement providing the project information requested and explaining the extenuating circumstances.

Project Name: MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT	
Part A. General Company Information	
Company Name:	
Address:	
Contact Phone:	Contact E-mail:
Years in business as a Prime Contractor:	Years in business as a subcontractor:
Years in business under Present Name:	
List any former company names under which the company, its owners, and/or its principals has operated in the past five (5) years.	
Explain reason for name change(s) in the past five (5) years)	
Part B. Delinquent State Taxes	
Is the bidder listed on the Washington State Department of Revenue's "Delinquent Taxpayer List" website: http://dor.wa.gov/content/fileandpaytaxes/latefiling/dtlwest.aspx	
Yes <input type="checkbox"/>	No <input type="checkbox"/>
If "Yes" attach a copy of the written payment plan approved by the Department of Revenue.	
Part C. Federal Debarment	
The bidder shall not be listed as a current debarred or suspended bidder on the Federal "System For Award Management" website www.sam.gov . Is the bidder listed as debarred or suspended?	
Yes <input type="checkbox"/>	No <input type="checkbox"/>
Sam.gov Unique Entity ID _____	

Part D. Subcontractor Responsibility
Does the bidder's standard subcontract form include the subcontractor language required by RCW 39.06.020? Does the bidder have an established procedure which it uses to validate the responsibility of each of its subcontractors? Does the subcontract form require that each of the bidder's subcontractors have and document a similar procedure for sub-tier subcontractors?
Yes <input type="checkbox"/> No <input type="checkbox"/>
If "Yes" or "No", provide a copy of its standard subcontract form and a copy of the procedures used to validate the responsibility of subcontractors.
Part E. Prevailing Wages
In the last five (5) years, has the bidder had prevailing wage complaints filed against it or received violations as determined by the applicable state or federal government agency monitoring prevailing and/or Davis-Bacon wage compliance?
Yes <input type="checkbox"/> No <input type="checkbox"/>
If "Yes," attach a separate signed/dated statement listing the prevailing wage violations, along with an explanation of each violation and how it was resolved. The City shall evaluate these explanations and the resolution of each violation to determine whether the violations demonstrate a pattern of failure to pay prevailing wages to workers unless there are extenuating circumstances acceptable to the City.
Part F. Claims Against Retainage and Bonds
Does the bidder have a record of any claims filed against the retainage or payment bonds for public works projects during the previous three (3) years?
Yes <input type="checkbox"/> No <input type="checkbox"/>
If "Yes", attach a separate signed / dated statement for each project with claims which includes the following: 1) Owner and contact information for the owner; 2) a list of claims filed against the retainage and/or payment bond for the project; and 3) a written explanation of the circumstances surrounding the claim and the ultimate resolution of the claim. The City may contact previous owners to validate the information provided by the Bidder. The City shall evaluate the information to determine if it demonstrates a lack of effective management by the bidder of making timely and appropriate payments, unless there are extenuating circumstances acceptable to the City in its sole discretion.

Part G. Public Bidding Crime
Has the bidder been convicted of a crime involving bidding on a public works contract within the last five (5) years?
Yes <input type="checkbox"/> No <input type="checkbox"/>
Part H. Termination for Cause/Termination for Default
Has the bidder had any public works contract terminated for cause by any government agency during the previous five (5) years?
Yes <input type="checkbox"/> No <input type="checkbox"/>
If “Yes”, attach a separate signed / dated statement listing each contract terminated, the government agency terminating the contract and the circumstances involving the termination for cause. The City will determine if there are extenuating circumstances acceptable to the City in its sole discretion.
Part I. Lawsuits
Has the bidder been involved in lawsuits (or arbitrations for those instances where arbitration is completed in lieu of a lawsuit) with judgments entered against the bidder for failure to meet terms on contracts in the previous five (5) years?
Yes <input type="checkbox"/> No <input type="checkbox"/>
If “Yes”, attach a list of lawsuits and/or arbitrations with judgments / arbitration awards entered against the bidder along with a written explanation of the circumstances surrounding each lawsuit and/or arbitration.
Part J. Work Experience
List at least three construction projects on the attached Work Experience Form, each of which meet all of the following criteria:
<ul style="list-style-type: none"> • Successfully completed municipal well and booster pump station projects within the past 7 years • Work includes grinding and patching. • Contract value exceeding \$3,000,000.00.

Part K. Signature	
<i>I hereby certify, warrant and declare under penalty of perjury that the information included herein is correct and complete. Failure to disclose requested information or submitting false or misleading information may result in rejection of my bid, termination of my contract, and may impact my firm's ability to bid on future projects.</i>	
Signature of Authorized Representative	Date
Printed Name of Authorized Representative	Title

Work Experience Form

List at least three construction projects on the attached Work Experience Form, each of which meet all of the following criteria:

- Successfully completed within the last seven (7) years.
- Water main installation, connection, and repairs and roadway repair.
- Handling of asbestos materials
- Contract value exceeding \$100,000.00.

1. _____

Contract Value \$ _____

2. _____

Contract Value \$ _____

3. _____

Contract Value \$ _____

4. _____

Contract Value \$ _____

5. _____

Contract Value \$ _____

SUBCONTRACTOR LIST

Per RCW 39.30.060, the bidder is required to submit as part of the bid the names of the subcontractors with whom the bidder will subcontract for performance of the work of HVAC (heating, ventilation, and air conditioning), plumbing as described in chapter 18.106 RCW, and electrical as described in chapter 19.28 RCW, or to name itself for the work and is also required to list the names of subcontractors with whom the bidder will subcontract for performance of the work of structural steel installation and rebar installation. The bidder shall not list more than one subcontractor for each category of work identified, unless subcontractors vary with bid alternates, in which case the bidder must indicate which subcontractor will be used for which alternate.

The work to be performed is to be listed below the subcontractor(s) name. The requirement to name the bidder's proposed HVAC, plumbing, electrical, structural steel installation, and rebar installation subcontractors applies only to proposed HVAC, plumbing, electrical, structural steel installation, and rebar installation subcontractors who will contract directly with the bidder submitting the bid to the public entity.

Failure to list subcontractors who are proposed to perform the work of HVAC (heating, ventilation and air conditioning), plumbing, and electrical, or to name itself to perform such work, or failing to name subcontractors who are proposed to perform structural steel installation or rebar installation, or naming more than one subcontractor to perform the same work will result in your bid being non-responsive and therefore void.

Subcontractor Name _____
Work to be Performed _____

Subcontractor Name _____
Work to be Performed _____

Subcontractor Name _____
Work to be Performed _____

Subcontractor Name
Work to be Performed

Subcontractor Name
Work to be Performed

CONTRACT DOCUMENTS

CONTRACT

**CITY OF PORT ORCHARD
MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT
PUBLIC WORKS PROJECT NO. PW2023-010
CONTRACT NO. C _____**

THIS CONTRACT ("Contract") is made and entered into this ____ day of _____, 20__, by and between the City of Port Orchard, a municipality incorporated and existing under the laws of the State of Washington, hereinafter called the "City," and _____, hereinafter called the "Contractor."

WITNESSETH:

I. General Provisions.

A. Description of Work.

The Contractor, in consideration of the covenants, agreements and payments to be performed and made by the City, hereby covenants and agrees to furnish all labor, tools, materials, equipment and supplies required for, and to execute, construct and finish in full compliance with the Contract Documents, **McCormick Woods - Well No. 11 Site Improvement Project**. The Contractor further agrees to perform all such work for the Contract Price stated in the Contractor's Bid Proposal dated _____, attached hereto and incorporated herein by this reference as if set forth in full. Contractor further represents that the services furnished under this Agreement will be performed in accordance with and as described in the attached plans and specifications and with the Port Orchard Municipal Code, the City's Public Works Standards, which includes (but is not limited to) the 2021 edition of the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (which shall apply except where noted otherwise). All of these standards are by this reference incorporated herein and made a part hereof. Contractor further represents that the services furnished under this Agreement will be performed in accordance with generally accepted professional practices within the Puget Sound region in effect at the time such services are performed.

The Contract Documents include:

Exhibit A -a confirmed copy of the Proposal made by the Contractor on _____, together with the Instructions to Bidders.

Exhibit B – The Project Manual for the **MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT**.

Exhibit C – Retainage Options

All Exhibits to this Contract are by this reference incorporated herein and made a part hereof as if set forth in full.

B. Time of Completion.

Time is of the essence of this Contract. It is agreed that the work covered by this Contract shall start within 14 calendar days after Notice to Proceed is issued and that all construction shall be complete within **350 working days** after the Notice to Proceed Date.

C. Liquidated Damages.

It is further agreed that the City will suffer damage and be put to additional expense in the event that the Contractor shall not have the specified portions of the work completed in all its parts in the time specified, and as it may be difficult to accurately compute the amount of such damage, the Contractor expressly covenants and agrees to pay to the City liquidated damages, the sum as calculated by the equation shown in Section 1-08.9 of the WSDOT Standard Specifications, for each and every working day said work is not complete beyond the time shown in the Proposal.

II. Non-Discrimination.

During the performance of this Contract, the Contractor, for itself, its assignees, and successors in interest agrees to comply with the following non-discrimination statutes and authorities; including but not limited to compliance with the following Pertinent Non-Discrimination Authorities:

- Title VI of the Civil Rights Act of 1964 (42 U.S.C. § 2000d et seq., 78 stat. 252), (prohibits discrimination on the basis of race, color, national origin); and 49 C.F.R. Part 21.
- The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, (42 U.S.C. § 4601), (prohibits unfair treatment of persons displaced or whose property has been acquired because of Federal or Federal-aid programs and projects);
- Federal-Aid Highway Act of 1973, (23 U.S.C. § 324 et seq.), (prohibits discrimination on the basis of sex);
- Section 504 of the Rehabilitation Act of 1973, (29 U.S.C. § 794 et seq.), as amended, (prohibits discrimination on the basis of disability); and 49 C.F.R. Part 27;
- The Age Discrimination Act of 1975, as amended, (42 U.S.C. § 6101 et seq.), (prohibits discrimination on the basis of age);
- Airport and Airway Improvement Act of 1982, (49 USC§ 471, Section 4 7123), as amended, (prohibits discrimination based on race, creed, color, national origin, or sex);
- The Civil Rights Restoration Act of 1987, (PL 100-209), (Broadened the scope, coverage and applicability of Title VI of the Civil Rights Act of 1964, The Age Discrimination Act of 1975 and Section 504 of the Rehabilitation Act of 1973, by expanding the definition of the terms "programs or activities" to include all of the programs or activities of the Federal-aid recipients, sub- recipients and contractors, whether such programs or activities are Federally funded or not);

- Titles II and III of the Americans with Disabilities Act, which prohibit discrimination on the basis of disability in the operation of public entities, public and private transportation systems, places of public accommodation, and certain testing entities (42 U.S.C. §§ 12131-12189) as implemented by Department of Transportation regulations at 49 C.F.R. parts 37 and 38;
- The Federal Aviation Administration's Non-discrimination statute (49 U.S.C. § 47123) (prohibits discrimination on the basis of race, color, national origin, and sex);
- Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, which ensures discrimination against minority populations by discouraging programs, policies, and activities with disproportionately high and adverse human health or environmental effects on minority and low-income populations;
- Executive Order 13166, Improving Access to Services for Persons with Limited English Proficiency, and resulting agency guidance, national origin discrimination includes discrimination because of limited English proficiency (LEP). To ensure compliance with Title VI, you must take reasonable steps to -ensure that LEP persons have meaningful access to your programs (70 Fed. Reg. at 74087 to 74100);
- Title IX of the Education Amendments of 1972, as amended, which prohibits you from discriminating because of sex in education programs or activities (20 U.S.C. 1681 et seq).

Title VI of the Civil Rights Act of 1964

The City of Port Orchard, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation subtitle A, Office of the Secretary, Part 21, nondiscrimination in federally assisted programs of the Department of Transportation issued pursuant to such Act, must affirmatively ensure that its contracts comply with these regulations.

Also, in accordance with Title VI, the City is required to include the following clauses in every contract subject to Title VI and its related regulations.

Therefore, during the performance of this Contract, the Contractor, for itself, its assignees, and successors in interest agrees as follows:

1. **Compliance with Regulations:** The Contractor will comply with the Acts and the regulations relative to Nondiscrimination in Federally-assisted programs of the U.S. Department of Transportation, Federal Highway Administration (FHWA), as they may be amended from time to time, which are herein incorporated by reference and made a part of this Contract.
2. **Nondiscrimination:** The Contractor, with regard to the work performed by it during this Contract, will not discriminate on the grounds of race, color, national origin, sex, age, disability, income-level, or LEP in the selection and retention of subcontractors, including

procurements of materials and leases of equipment. The Contractor will not participate directly or indirectly in the discrimination prohibited by the Acts and the Regulations as set forth herein, including employment practices when this Contract covers any activity, project, or program set forth in Appendix B of 49 C.F.R. part 21.

3. **Solicitations for Subcontracts, Including Procurements of Materials and Equipment:** In all solicitations, either by competitive bidding, or negotiation made by the Contractor for work to be performed under a subcontract, **including** procurements of materials, or leases of equipment, each potential subcontractor or supplier will be notified by the Contractor of the Contractor's obligations under this Contract and the Acts and the Regulations relative to Non-discrimination on the grounds of race, color, national origin, sex, age, disability, income-level, or LEP.
4. **Information and Reports:** The Contractor will provide all information and reports required by the Acts, the Regulations and directives issued pursuant thereto and will permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by the City or the FHWA to be pertinent to ascertain compliance with such Acts, Regulations, and instructions. Where any information required of the Contractor is in the exclusive possession of another who fails or refuses to furnish the information, the Contractor will so certify to the City or the FHWA, as appropriate, and will set forth what efforts it has made to obtain the information.
5. **Sanctions for Noncompliance:** In the event of the Contractor's noncompliance with the Non-discrimination provisions of this Contract, the City will impose such contract sanctions as it or the FHWA may determine to be appropriate, including, but not limited to:
 1. withholding payments to the Contractor under the Contract until the Contractor complies; and/or
 2. cancelling, terminating, or suspending the Contract, in whole or in part.
6. **Incorporation of Provisions:** The Contractor will include the provisions of paragraphs one through six in every subcontract, including procurements of materials and leases of equipment, unless exempt by the Acts, the Regulations and directives issued pursuant thereto. The Contractor will take action with respect to any subcontract or procurement as the City or the FHWA may direct as a means of enforcing such provisions including sanctions for noncompliance. Provided, that if the Contractor becomes involved in, or is threatened with litigation by a subcontractor, or supplier because of such direction, the Contractor may request the City to enter into any litigation to protect the interests of the City. In addition, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

III. Public Records Act Chapter 42.56 RCW

Contractor understands that their bid response documents, and any contract documents may be subject to release under the Public Records Act Chapter 42.56 RCW and the City may be required to disclose such documents upon a request. Contractor acknowledges that they have been advised to mark any records believed to be trade secrets or confidential in nature as “confidential.” If records marked as “confidential” are found to be responsive to the request for records, the City as a courtesy to the Contractor, may elect to give notice to Contractor of the request so as to allow Contractor to seek a protective order from a Court. Contractor acknowledges and agrees that any records deemed responsive to a public records request may be released at the sole discretion of, and without notice by, the City.

IV. Termination

The City may terminate this contract for cause or for convenience.

- 1. Termination for Cause.** The City may, upon 7 days written notice to Contractor and to its surety, terminate (without prejudice to any right or remedy of the City) the contract, or any part of it, for cause upon the occurrence of any one or more of the following events: Contractor fails to complete the work or any portion thereof with sufficient diligence to ensure substantial completion of the work within the contract time; Contractor is adjudged bankrupt, makes a general assignment for the benefit of its creditors, or a receiver is appointed on account of its insolvency; Contractor fails in a material way to replace or correct work not in conformance with the Contract Documents, Contractor repeatedly fails to supply skilled workers or proper materials or equipment; Contractor materially disregards or fails to comply with laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction; or Contractor is otherwise in material breach of any provision of the contract. Upon termination, the City may, at its option, take possession of or use all documents, materials, equipment, tools, and construction equipment and machinery thereon owned by Contractor to maintain the orderly progress of, and to finish, the work, and finish the work by whatever other reasonable method it deems expedient.
- 2. Termination for Convenience.** The City may, upon written notice, terminate (without prejudice to any right or remedy of the City) the contract, or any part of it, for the convenience of the City.
- 3. Settlement of Costs.** If the City terminates for convenience, Contractor shall be entitled to make a request for an equitable adjustment for its reasonable direct costs incurred prior to the effective date of the termination, plus a reasonable allowance for overhead and profit on work performed prior to termination, plus the reasonable administrative costs of the termination, but shall not be entitled to any other costs or damages,

whatsoever, provided however, the total sum payable upon termination shall not exceed the Contract Sum reduced by prior payments.

V. Corporate Surety Bond

With this Contract, Contractor is furnishing a Corporate Surety Bond in the amount of

_____ Dollars (\$ _____) with _____
as Surety, to ensure full compliance, execution and performance of this Contract by the Contractor in accordance with all its terms and provisions.

VI. Independent Contractor.

The parties intend that an Independent Contractor-Employer Relationship will be created by this Agreement and that the Contractor has the ability to control and direct the performance and details of its work, the City being interested only in the results obtained under this Agreement.

VII. Employment of State Retirees.

The City is a “DRS-covered employer” which is an organization that employs one or more members of any retirement system administered by the Washington State Department of Retirement Systems (DRS). Pursuant to RCW 41.50.139(1) and WAC 415-02-325(1), the City is required to elicit on a written form if any of the Contractor’s employees providing services to the City retired using the 2008 Early Retirement Factors (ERFs), or if the Contractor is owned by an individual who retired using the 2008 ERFs, and whether the nature of the service and compensation would result in a retirement benefit being suspended. Failure to make this determination exposes the City to significant liability for pension overpayments. As a result, before commencing work under this Agreement, Contractor shall determine whether any of its employees providing services to the City or any of the Contractor’s owners retired using the 2008 ERFs, and shall immediately notify the City and shall promptly complete the form provided by the City after this notification is made. This notification to DRS could impact the payment of retirement benefits to employees and owners of Contractor. Contractor shall indemnify, defend, and hold harmless the City from any and all claims, damages, or other liability, including attorneys’ fees and costs, relating to a claim by DRS of a pension overpayment caused by or resulting from Contractor’s failure to comply with the terms of this provision. This provision shall survive termination of this Agreement.

VIII. Changes.

The City may issue a written change order for any change in the Contract work during the performance of this Agreement. If the Contractor determines, for any reason, that a change order is necessary, Contractor must submit a written change order request to the person listed in the Notice provision section of this Agreement, within fourteen (14) calendar days of the date Contractor knew or should have known of the facts and events giving rise to the requested change. If the City determines that the change increases or decreases the Contractor's costs or time for performance, the City will make an equitable adjustment. The City will attempt, in good faith, to reach agreement with the Contractor on all equitable adjustments. However, if the parties are unable to agree, the City will determine the equitable adjustment as it deems appropriate. The Contractor shall proceed with the change order work upon receiving either a written change order from the City or an oral order from the City before actually receiving the written change order. If the Contractor fails to require a change order within the time specified in this paragraph, the Contractor waives its right to make any claim or submit subsequent change order requests for that portion of the contract work. If the Contractor disagrees with the equitable adjustment, the Contractor must complete the change order work; however, the Contractor may elect to protest the adjustment as provided in subsections A through E of Section IX entitled, "Claims," below.

The Contractor accepts all requirements of a change order by: (1) endorsing it, (2) writing a separate acceptance, or (3) not protesting in the way this section provides. A change order that is accepted by Contractor as provided in this section shall constitute full payment and final settlement of all claims for contract time and for direct, indirect and consequential costs, including costs of delays related to any work, either covered or affected by the change.

IX. Claims. If the Contractor disagrees with anything required by a change order, another written order, or an oral order from the City, including any direction, instruction, interpretation, or determination by the City, the Contractor may file a claim as provided in this section. The Contractor shall give written notice to the City of all claims within fourteen (14) calendar days of the occurrence of the events giving rise to the claims, or within fourteen (14) calendar days of the date the Contractor knew or should have known of the facts or events giving rise to the claim, whichever occurs first. Any claim for damages, additional payment for any reason, or extension of time, whether under this Agreement or otherwise, shall be conclusively deemed to have been waived by the Contractor unless a timely written claim is made in strict accordance with the applicable provisions of this Agreement.

At a minimum, a Contractor's written claim shall include the information set forth in subsections A, items 1 through 5 below.

FAILURE TO PROVIDE A COMPLETE, WRITTEN NOTIFICATION OF CLAIM WITHIN THE TIME ALLOWED SHALL BE AN ABSOLUTE WAIVER OF ANY CLAIMS ARISING IN ANY WAY FROM THE FACTS OR EVENTS SURROUNDING THAT CLAIM OR CAUSED BY THAT DELAY.

A. Notice of Claim. Provide a signed written notice of claim that provides the following information:

1. The date of the Contractor's claim;
2. The nature and circumstances that caused the claim;
3. The provisions in this Agreement that support the claim;
4. The estimated dollar cost, if any, of the claimed work and how that estimate was determined; and
5. An analysis of the progress schedule showing the schedule change or disruption if the Contractor is asserting a schedule change or disruption.

B. Records. The Contractor shall keep complete records of extra costs and time incurred as a result of the asserted events giving rise to the claim. The City shall have access to any of the Contractor's records needed for evaluating the protest.

The City will evaluate all claims, provided the procedures in this section are followed. If the City determines that a claim is valid, the City will adjust payment for work or time by an equitable adjustment. No adjustment will be made for an invalid protest.

C. Contractor's Duty to Complete Protested Work. In spite of any claim, the Contractor shall proceed promptly to provide the goods, materials and services required by the City under this Agreement.

D. Failure to Protest Constitutes Waiver. By not protesting as this section provides, the Contractor also waives any additional entitlement and accepts from the City any written or oral order (including directions, instructions, interpretations, and determination).

E. Failure to Follow Procedures Constitutes Waiver. By failing to follow the procedures of this section, the Contractor completely waives any claims for protested work and accepts from the City any written or oral order (including directions, instructions, interpretations, and determination).

X. Limitation Of Actions.

CONTRACTOR MUST, IN ANY EVENT, FILE ANY LAWSUIT ARISING FROM OR CONNECTED WITH THIS AGREEMENT WITHIN 120 CALENDAR DAYS FROM THE DATE THE CONTRACT WORK IS COMPLETE OR CONTRACTOR'S ABILITY TO FILE THAT CLAIM OR SUIT SHALL BE FOREVER BARRED. THIS SECTION FURTHER LIMITS ANY APPLICABLE STATUTORY LIMITATIONS PERIOD.

XI. Warranty.

Upon acceptance of the contract work, Contractor must provide the City a two-year warranty bond in the amount of twenty percent (20%) of the contract price a form and amount acceptable to the City. The Contractor shall correct all defects in workmanship and materials within two (2) years from the date of the City's acceptance of the Contract work, including replacing vegetation that fails to thrive. In the event any parts are repaired or replaced, only original replacement parts shall be used—rebuilt or used parts will not be acceptable. When defects are corrected, the warranty for that portion of the work shall extend for one (1) additional year from the date such correction is completed and accepted by the City. The Contractor shall begin to correct any defects within seven (7) calendar days of its receipt of notice from the City of the defect. If the Contractor does not accomplish the corrections within a reasonable time as determined by the City, the City may complete the corrections and the Contractor shall pay all costs incurred by the City in order to accomplish the correction.

XII. Indemnification.

Contractor shall defend, indemnify, and hold the City, its officers, officials, employees, agents and volunteers harmless from any and all claims, injuries, damages, losses or suits, including all legal costs and attorney fees, arising out of or in connection with the Contractor's performance of this Agreement, except for that portion of the injuries and damages caused by the sole negligence of the City.

The City's inspection or acceptance of any of Contractor's work when completed shall not be grounds to avoid any of these covenants of indemnification.

Should a court of competent jurisdiction determine that this Agreement is subject to RCW 4.24.115, then, in the event of liability for damages arising out of bodily injury to persons or damages to property caused by or resulting from the concurrent negligence of the Contractor and the City, its officers, officials, employees, agents and volunteers, the Contractor's liability hereunder shall be only to the extent of the Contractor's negligence.

It is further specifically and expressly understood that the indemnification provided herein constitutes the contractor's waiver of immunity under Industrial Insurance, Title 51 RCW, solely for the purposes of this indemnification. The parties further acknowledge that they have mutually negotiated this waiver.

THE PROVISIONS OF THIS SECTION SHALL SURVIVE THE EXPIRATION OR TERMINATION OF THIS AGREEMENT.

XIII. Insurance.

The Contractor shall procure and maintain for the duration of the Agreement, insurance against claims for injuries to persons or damage to property which may arise from or in connection with

the performance of the work hereunder by the Contractor, its agents, representative, employees or subcontractors.

No Limitation. Contractor's maintenance of insurance as required by the agreement shall not be construed to limit the liability of the Contractor to the coverage provided by such insurance, or otherwise limit the City's recourse to any remedy available at law or in equity.

A. Minimum Scope of Insurance. Contractor shall obtain insurance of the types described below:

1. Automobile Liability insurance covering all owned, non-owned, hired and leased vehicles. Coverage shall be written on Insurance Services Office (ISO) form CA 00 01 or a substitute form providing equivalent liability coverage. If necessary, the policy shall be endorsed to provide contractual liability coverage.

2. Commercial General Liability insurance shall be written on ISO occurrence form CG 00 01 and shall cover liability arising from premises, operations, stop gap liability, independent contractors, products-completed operations, personal injury and advertising injury, and liability assumed under an insured contract. The Commercial General Liability insurance shall be endorsed to provide the Aggregate Per Project Endorsement ISO form CG 25 03 11 85. There shall be no endorsement or modification of the Commercial General Liability insurance for liability arising from explosion, collapse or underground property damage. The City shall be named as an insured under the Contractor's Commercial General Liability insurance policy with respect to the work performed for the City using ISO Additional Insured endorsement CG 20 10 10 01 and Additional Insured-Completed Operations endorsement CG 20 37 10 01 or substitute endorsements providing equivalent coverage.

3. Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington.

4. Builders Risk insurance covering interests of the City, the Contractor, Subcontractors, and Sub-subcontractors in the work. Builders Risk insurance shall be on a all-risk policy form and shall insure against the perils of fire and extended coverage and physical loss or damage including flood and earthquake, theft, vandalism, malicious mischief, collapse, temporary buildings and debris removal. This Builders Risk insurance covering the work will have a deductible of \$5,000 for each occurrence, which will be the responsibility of the Contractor. Higher deductibles for flood and earthquake perils may be accepted by the City upon written request by the Contractor and written acceptance by the City. Any increased deductibles accepted by the City will remain the responsibility of the Contractor. The Builders Risk insurance shall be maintained until final acceptance of the work by the City.

B. Minimum Amounts of Insurance. Contractor shall maintain the following insurance limits:

City of Port Orchard

McCormick Woods - Well No. 11 – Site Improvements Project Public Works Project # PW2023-010

LD-46

1. Automobile Liability insurance with a minimum combined single limit for bodily injury and property damage of \$1,000,000 per accident.
 2. Commercial General Liability insurance shall be written with limits no less than \$3,000,000 each occurrence, \$3,000,000 general aggregate and a \$3,000,000 products-completed operations aggregate limit.
 3. Builders Risk insurance shall be written in the amount of the completed value of the project with no coinsurance provisions.
- C. Other Insurance Provisions. The insurance policies are to contain, or be endorsed to contain, the following provisions for Automobile Liability, Commercial General Liability and Builders Risk insurance:
1. The Contractor's insurance coverage shall be primary insurance as respect the City. Any insurance, self-insurance, or insurance pool coverage maintained by the City shall be excess of the Contractor's insurance and shall not contribute with it.
 2. The Contractor's insurance shall be endorsed to state that coverage shall not be cancelled by either party, except after thirty (30) days prior written notice by certified mail, return receipt requested, has been given to the City.
- D. Contractor's Insurance for Other Losses. The Contractor shall assume full responsibility for all loss or damage from any cause whatsoever to any tools, Contractor's employee-owned tools, machinery, equipment, or motor vehicles owned or rented by the Contractor, or the Contractor's agents, suppliers or contractors as well as to any temporary structures, scaffolding and protective fences.
- E. Waiver of Subrogation. The Contractor and the City waive all rights against each other any of their Subcontractors, Sub-subcontractors, agents and employees, each of the other, for damages caused by fire or other perils to the extend covered by Builders Risk insurance or other property insurance obtained pursuant to the Insurance Requirements Section of this Contract or other property insurance applicable to the work. The policies shall provide such waivers by endorsement or otherwise.
- F. Acceptability of Insurers. Insurance is to be placed with insurers with a current A.M. Best rating of not less than A:VII.
- G. Verification of Coverage. Contractor shall furnish the City with original certificates and a copy of the amendatory endorsements, including but not necessarily limited to the additional insured endorsement, evidencing the Automobile Liability and Commercial General Liability insurance of the Contractor before commencement of the work. Before any exposure to loss may occur, the Contractor shall file with the City a copy of the Builders Risk insurance policy that

includes all applicable conditions, exclusions, definitions, terms and endorsements related to this Project.

H. Subcontractors. Contractor shall ensure that each subcontractor of every tier obtain at a minimum the same insurance coverage and limits as stated herein for the Contractor (with the exception of Builders Risk insurance). Upon request the City, the Contractor shall provide evidence of such insurance.

XIV. WORK PERFORMED AT CONTRACTOR'S RISK. Contractor shall take all necessary precautions and shall be responsible for the safety of its employees, agents, and subcontractors in the performance of the contract work and shall utilize all protection necessary for that purpose. All work shall be done at Contractor's own risk, and Contractor shall be responsible for any loss of or damage to materials, tools, or other articles used or held for use in connection with the work.

XV. Miscellaneous Provisions.

A. Non-Waiver of Breach. The failure of the City to insist upon strict performance of any of the covenants and agreements contained in this Agreement, or to exercise any option conferred by this Agreement in one or more instances shall not be construed to be a waiver or relinquishment of those covenants, agreements or options, and the same shall be and remain in full force and effect.

B. Resolution of Disputes and Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of Washington. If the parties are unable to settle any dispute, difference or claim arising from the parties' performance of this Agreement, the exclusive means of resolving that dispute, difference or claim, shall only be by filing suit exclusively under the venue, rules and jurisdiction of the Kitsap County Superior Court, Kitsap County, Washington, unless the parties agree in writing to an alternative dispute resolution process. In any claim or lawsuit for damages arising from the parties' performance of this Agreement, each party shall pay all its legal costs and attorney's fees incurred in defending or bringing such claim or lawsuit, including all appeals, in addition to any other recovery or award provided by law; provided, however, nothing in this paragraph shall be construed to limit the City's right to indemnification under Section XII of this Agreement.

C. Written Notice. All communications regarding this Agreement shall be sent to the parties at the addresses listed on the signature page of the Agreement, unless notified to the contrary. Any written notice hereunder shall become effective three (3) business days after the date of mailing by registered or certified mail, and shall be deemed sufficiently given if sent to the addressee at the address stated in this Agreement or such other address as may be hereafter specified in writing.

D. Assignment. Any assignment of this Agreement by either party without the written consent of the non-assigning party shall be void. If the non-assigning party gives its consent to

any assignment, the terms of this Agreement shall continue in full force and effect and no further assignment shall be made without additional written consent.

E. Modification. No waiver, alteration, or modification of any of the provisions of this Agreement shall be binding unless in writing and signed by a duly authorized representative of the City and Contractor.

F. Entire Agreement. The written provisions and terms of this Agreement, together with any Exhibits attached hereto, shall supersede all prior verbal statements of any officer or other representative of the City, and such statements shall not be effective or be construed as entering into or forming a part of or altering in any manner this Agreement. All of the above documents are hereby made a part of this Agreement. However, should any language in any of the Exhibits to this Agreement conflict with any language contained in this Agreement, the terms of this Agreement shall prevail.

G. Compliance with Laws. The Contractor agrees to comply with all federal, state, and municipal laws, rules, and regulations that are now effective or in the future become applicable to Contractor's business, equipment, and personnel engaged in operations covered by this Agreement or accruing out of the performance of those operations.

H. Counterparts. This Agreement may be executed in any number of counterparts, each of which shall constitute an original, and all of which will together constitute this one Agreement. IN WITNESS WHEREOF the parties hereto have caused these presents to be duly executed.

CITY OF PORT ORCHARD

By: _____
Robert Putaansuu, Mayor

CONTRACTOR

By: _____

Title: _____

Address: _____

ATTEST:

Brandy Wallace, MMC, City Clerk

APPROVED AS TO FORM:

Charlotte Archer, City Attorney

NOTICES TO BE SENT TO:

CONTRACTOR:

CITY

Name: _____

Robert Putaansuu

Address: _____

216 Prospect Street

Port Orchard, WA 98366

Telephone: _____

Telephone: 360 876-4407

Email: _____

Email: cityclerk@portorchardwa.gov

With a copy to the City Clerk at the same address

EXHIBIT C
5% RETAINAGE INVESTMENT OPTION¹

Contractor: _____

Project Name: **MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT**

Date: _____ Project Number: **PW2023-010**

Pursuant to RCW 60.28.010, as amended, you may exercise an option as to how the 5% retainage under this contract will be invested. Please complete and sign this form indicating your preference. If you fail to do so you will miss the benefit of any interest earned. Select one of the following options:

1. **Savings Account:** Money will be placed in an interest-bearing account. The interest will be paid to you directly, rather than kept on deposit. If this is your choice, then please complete attached *SAVINGS ACCOUNT AGREEMENT*. Please state the name of your bank.

Bank: _____

2. **Escrow/Investments:** The City will deliver retainage checks to a selected bank, pursuant to an escrow agreement. The bank will then invest the funds in securities or bonds selected by you, and interest will be paid to you as it accrues. If this is your choice then please complete attached *ESCROW AGREEMENT*.

Preferred Bank: _____

Securities/Bonds: _____

3. **Guarantee Deposit:** Retainage will be held by the City. No interest is payable to the Contractor

Retainage is normally released 45 days after final acceptance of the work or following receipt of Labor and Industries/Department of Revenue clearance, whichever date is the later. Retainage on landscaping work may be longer, due to its seasonal nature. However, if this project is subject to grant funding, then the retainage may also be held until such time as the Contractor meets its obligations to the City to provide required information and documentation for compliance with the grant funding requirements.

State law allows for limited early release of retainage in certain circumstances.

Contractor's Signature

Title

¹ If the Contractor opts to post a retainage bond under RCW 60.28.011, such bond shall be in a form acceptable to the City, shall be with a surety with a minimum of A.M. Best financial strength rating of a minimum of A-.

SAVING ACCOUNT AGREEMENT

TO BANK: _____ SAVINGS ACCOUNT NO: _____

BANK'S ADDRESS: _____

AGENCY: CITY OF PORT ORCHARD
216 Prospect Street
Port Orchard WA 98366

CONTRACT NO: _____

PROJECT TITLE: _____

The estimated completion date of contract is: _____

The undersigned, _____, herein referred to as the CONTRACTOR, has directed the CITY OF PORT ORCHARD, Washington, hereinafter referred to as the AGENCY, to deliver to you its warrants which shall be payable to you and the CONTRACTOR jointly. Such warrants are to be held and disposed of by you in accordance with the following instructions and upon the terms and conditions hereinafter set forth.

INSTRUCTIONS

1. Warrants or checks made payable to you and the CONTRACTOR jointly upon delivery to you shall be endorsed by you and forwarded for collection. The moneys will then be placed by you in an interest-bearing savings account.
2. When and as interest on the savings account accrues and is paid, you shall collect such interest and forward it to the CONTRACTOR at its address designated below unless otherwise directed by the CONTRACTOR.
3. You are not authorized to deliver to the CONTRACTOR all or any part of the principal held by you pursuant to this agreement, except in accordance with written instruction from the AGENCY. Compliance with such instructions shall relieve you of any further liability related thereto.
4. The CONTRACTOR agrees to pay you as compensation for your services hereunder as follows:
Payment of all fees shall be the sole responsibility of the CONTRACTOR and shall not be deducted from any moneys placed with you pursuant to this agreement until and unless the AGENCY directs the release to the CONTRACTOR, whereupon you shall be granted a first lien upon such moneys released and shall be entitled to reimburse yourself from such moneys for the entire amount of your fees as provided for herein above. In the event that you are made a party to any litigation with respect to the moneys held by you hereunder, or in the event that the conditions of this agreement are not promptly fulfilled, or that you are required to render any service not provided for in these

instructions, or that there is any assignment of the interests of this agreement, or any modification hereof, you shall be entitled to reasonable compensation for such extraordinary services from the CONTRACTOR and reimbursement from the CONTRACTOR for all costs and expenses, including attorney fees occasioned by such default, delay, controversy or litigation.

5. This agreement shall not be binding until executed by the CONTRACTOR and the AGENCY and accepted by you.
6. This instrument contains the entire agreement between you, the CONTRACTOR and the AGENCY. You are not a party to nor bound by any instrument or agreement other than this. You shall not be required to take notice of any default or any other matter nor be bound by nor required to give notice or demand, nor required to take any action whatever except as herein expressly provided. You shall not be liable for any loss or damage not caused by your own negligence or willful misconduct.
7. The foregoing provisions shall be binding upon the assigns, successors, personal representative and heir of the Parties hereto.

Contractor

CITY OF PORT ORCHARD
Agency

BY: _____

BY: _____

Title: _____

Date: _____

Date: _____

Address: _____

The above savings account agreement and instruction received and accepted this _____ day of _____, 20__

Bank Name

Authorized Bank Officer

ESCROW AGREEMENT

TO BANK: _____ ESCROW NO.: _____

BANK'S ADDRESS: _____

AGENCY: CITY OF PORT ORCHARD
216 Prospect Street
Port Orchard WA 98366

CONTRACT NO.: _____

PROJECT TITLE: **MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT**

The estimated completion date of contract is: _____

The undersigned, _____, herein referred to as the CONTRACTOR, has directed the CITY OF PORT ORCHARD, Washington, hereinafter referred to as the AGENCY, to deliver to you its warrants which shall be payable to you and the CONTRACTOR jointly. Such warrants are to be held and disposed of by you in accordance with the following instructions and upon the terms and conditions hereinafter set forth.

INSTRUCTIONS

1. Warrants or checks made payable to you and the CONTRACTOR jointly upon delivery to you shall be endorsed by you and forwarded for collection. The moneys will then be used by you to purchase, as directed by the CONTRACTOR, bonds or other securities chosen by the CONTRACTOR and approved by the AGENCY. Attached is a list of such bonds, or other securities approved by the AGENCY. Other bonds or securities, except stocks may be selected by the CONTRACTOR, subject to express written approval of the AGENCY. Purchase of such bonds or other securities shall be in a form which shall allow you alone to reconvert such bonds or other securities into money if you are required to do so by the AGENCY as provided in Paragraph 4 of this Escrow Agreement.
2. When and as interest on the securities held by you pursuant to this agreement accrues and is paid, you shall collect such interest and forward it to the CONTRACTOR at its address designated below unless otherwise directed by the CONTRACTOR.
3. You are not authorized to deliver to the CONTRACTOR all or any part of the securities held by you pursuant to this agreement (or any moneys derived from the sale of such securities,

or the negotiation of the AGENCY'S warrants) except in accordance with written instructions from the AGENCY. Compliance with such instruction shall relieve you of any further liability related thereto.

4. In the event the AGENCY orders you to do so in writing, you shall within thirty-five (35) days of receipt of such order, reconvert into money the securities held by you pursuant to this agreement and return such money together with any other moneys held by you hereunder, to the AGENCY.
5. The CONTRACTOR agrees to pay you as compensation for your services hereunder as follows:

Payment of all fees shall be the sole responsibility of the CONTRACTOR and shall not be deducted from any property placed with you pursuant to this agreement until and unless the AGENCY directs the release to the CONTRACTOR of the securities and moneys held hereunder whereupon you shall be granted a first lien upon such property released and shall be entitled to reimburse yourself from such property for the entire amount of your fees as provided for herein above. In the event that are made a party to any litigation with respect to the property held by you hereunder, or in the event that the conditions of this escrow are not promptly fulfilled or that you are required to render any service not provided for in these instructions, or that there is any assignment of the interest of this escrow or any modification hereof, you shall be entitled to reasonable compensation for such extraordinary services from the CONTRACTOR and reimbursement from the CONTRACTOR for all costs and expenses, including attorney fees occasioned by such default, delay, controversy or litigation.

6. This agreement shall not be binding until executed by the CONTRACTOR and the AGENCY and accepted by you.
7. This instrument contains the entire agreement between you, the CONTRACTOR and the AGENCY with respect to this escrow and you are not a party to nor bound by any instrument or agreement other than this; you shall not be required to take notice of any default or any other matter nor be bound by nor be bound by nor required to give notice or demand , nor required to take action whatever except as herein expressly provided; you shall not be liable for any loss or damage not caused by your own negligence or willful misconduct.

The foregoing provision shall be binding upon the assigns, successors, personal representative, and heir of the Parties hereto.

Contractor

CITY OF PORT ORCHARD
Agency

By: _____ By: _____
Title: _____
Date: _____ Date: _____
Address: _____

The above escrow agreement and instruction received and accepted this _____ day of _____, 20__.

Bank Name

Authorized Bank Officer

SECURITIES AUTHORIZED BY AGENCY

1. Bills, certificates, notes or bonds of the United States;
2. Other obligations of the United States or its agencies;
3. Obligation of any corporation wholly-owned by the government of the United States;
4. Indebtedness of the Federal Nation Mortgage Association; and
5. Time deposits in commercial banks.

PERFORMANCE AND PAYMENT BOND

CITY OF PORT ORCHARD
MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT

PW PROJECT NO. PW2023-010

Bond to City of Port Orchard, Washington

Bond No. _____

We, _____, and _____
(Principal) (Surety)

a _____ Corporation, and as a surety corporation authorized to become a surety upon Bonds of Contractors with municipal corporations in Washington State, are jointly and severally bound to the City of Port Orchard, Washington ("Owner"), in the penal sum of _____ Dollars (\$_____), the payment of which sum, on demand, we bind ourselves and our successors, heirs, administrators, executors, or personal representatives, as the case may be. This Performance Bond is provided to secure the performance of Principal in connection with a contract dated _____, 20____, between Principal and Owner for a project entitled _____ ("Project") – Public Works Project No. _____ ("Contract"). The initial penal sum shall equal 100 percent of the Total Bid Price, including all applicable state sales tax, as specified in the Proposal submitted by Principal.

NOW, THEREFORE, this Performance and Payment Bond shall be satisfied and released only upon the condition that Principal:

Faithfully performs all provisions of the Contract and changes authorized by Owner in the manner and within the time specified as may be extended under the Contract;

Pays all laborers, mechanics, subcontractors, lower tier subcontractors, material-persons, and all other persons or agents who supply labor, equipment, or materials to the Project;

Pays the taxes, increases and penalties incurred on the Project under Titles 50, 51 and 82 RCW on: (A) Projects referred to in RCW 60.28.011(1)(b); and/or (B) Projects for which the bond is conditioned on the payment of such taxes, increases and penalties; and

Posts a two-year warranty/maintenance bond to secure the project. Such bond shall be in the amount of twenty percent (20%) of the project costs.

Provided, further that this bond shall remain in full force and effect until released in writing by the City at the request of the Surety or Principal.

The surety shall indemnify, defend, and protect the Owner against any claim of direct or indirect

loss resulting from the failure:

Of the Principal (or any of the employees, subcontractors, or lower tier subcontractors of the Principal) to faithfully perform the Contract, or

Of the Principal (or any subcontractor or lower tier subcontractor of the Principal) to pay all laborers, mechanics, subcontractors, lower tier subcontractors, material person, or any other person who provides supplies or provisions for carrying out the work.

The liability of Surety shall be limited to the penal sum of this Performance and Payment Bond.

No change, extension of time, alteration, or addition to the terms of the Contract or to the Work to be performed under the Contract shall in any way affect Surety's obligation on the Performance Bond. Surety hereby waives notice of any change, extension of time, alteration, or addition to the terms of the Contract or the Work, with the exception that Surety shall be notified if the Contract time is extended by more than twenty percent (20%).

If any modification or change increases the total amount to be paid under the Contract, Surety's obligation under this Performance and Payment Bond shall automatically increase in a like amount. Any such increase shall not exceed twenty-five percent (25%) of the original amount of the Performance and Payment Bond without the prior written consent of Surety.

This Performance and Payment Bond shall be governed and construed by the laws of the State of Washington, and venue shall be in Kitsap County, Washington.

IN WITNESS WHEREOF, the parties have executed this instrument in two (2) identical counterparts this _____ day of _____, 20 ____.

Principal

Surety

Signature of Authorized Official

Signature of Authorized Official

Printed Name and Title

By _____
Attorney in Fact (Attach Power of Attorney)

Name and address of local office of
Agent and/or Surety Company:

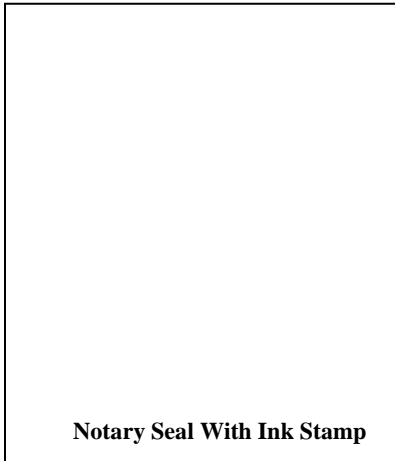
Surety companies executing bonds must appear on the current Authorized Insurance List in the State of Washington per Section 1-02.7 of the Standard Specifications.

SURETY ACKNOWLEDGEMENT

STATE OF _____)
)ss.
COUNTY OF _____)

On this _____ day of _____, 20____, before me, the undersigned, a Notary Public in and for the State of Washington, duly commissioned and sworn, personally appeared _____, to me known to be the _____ of _____, the corporation that executed the foregoing instrument, and acknowledged the said instrument to be the free and voluntary act and deed of said corporation, for the uses and purposes therein mentioned, and on oath stated that they are authorized to execute said instrument.

WITNESS my hand and official seal hereto affixed the day and year first above written.



Print or type name

NOTARY PUBLIC,
in and for the State of Washington
Residing _____
My Commission expires: _____

CITY OF PORT ORCHARD
MAINTENANCE/WARRANTY BOND

Project #: PW-2023-010
Surety Bond #: _____
Date Posted: _____
Expiration Date: _____

RE: Project Name: **MCCORMICK WOODS - WELL NO. 11 SITE IMPROVEMENT PROJECT**

Owner/Developer/Contractor: _____
Project Address: _____

KNOW ALL PERSONS BY THESE PRESENTS: That we, _____ (hereinafter called the "Principal"), and _____, a corporation organized under the laws of the State of _____, and authorized to transact surety business in the State of Washington (hereinafter called the "Surety"), are held and firmly bound unto the City of Port Orchard, Washington, in the sum of _____ dollars (\$ _____) 20% of the total contract amount, lawful money of the United States of America, for the payment of which sum we and each of us bind ourselves, our heirs, executors, administrators, successors and assigns, jointly and severally, by these presents. THE CONDITIONS of the above obligation are such that:

WHEREAS, the above named Principal has constructed and installed certain improvements on public property in connection with a project as described above within the City of Port Orchard; and

WHEREAS, the Principal is required to post a bond for the twenty-four (24) months following written and final acceptance of the project in order to provide security for the obligation of the Principal to repair and/or replace said improvements against defects in workmanship, materials or installation during the twenty-four (24) months after written and final approval/acceptance of the same by the City;

NOW, THEREFORE, this Maintenance Bond has been secured and is hereby submitted to the City. It is understood and agreed that this obligation shall continue in effect until released in writing by the City, but only after the Principal has performed and satisfied the following conditions:

A. The work or improvements installed by the Principal and subject to the terms and conditions of this Bond are as follows: (insert complete description of work here)

B. The Principal and Surety agree that the work and improvements installed in the above-referenced project shall remain free from defects in material, workmanship and installation (or, in the case of landscaping, shall survive,) for a period of twenty-four (24) months after written

and final acceptance of the same and approval by the City. Maintenance is defined as acts carried out to prevent a decline, lapse or cessation of the state of the project or improvements as accepted by the City during the twenty-four (24) month period after final and written acceptance, and includes, but is not limited to, repair or replacement of defective workmanship, materials or installations.

C. The Principal shall, at its sole cost and expense, carefully replace and/or repair any damage or defects in workmanship, materials or installation to the City-owned real property on which improvements have been installed and leave the same in as good condition or better as it was before commencement of the work.

D. The Principal and the Surety agree that in the event any of the improvements or restoration work installed or completed by the Principal as described herein, fail to remain free from defects in materials, workmanship or installation (or in the case of landscaping, fail to survive), for a period of twenty-four (24) months from the date of approval/acceptance of the work by the City, the Principal shall repair and/replace the same within ten (10) days of demand by the City, and if the Principal should fail to do so, then the Surety shall:

1. Within twenty (20) days of demand of the City, make written commitment to the City that it will either:
 - a). remedy the default itself with reasonable diligence pursuant to a time schedule acceptable to the City; or
 - b). tender to the City within an additional ten (10) days the amount necessary, as determined by the City, for the City to remedy the default, up to the total bond amount.

Upon completion of the Surety's duties under either of the options above, the Surety shall then have fulfilled its obligations under this bond. If the Surety elects to fulfill its obligation pursuant to the requirements of subsection D(1)(b), the City shall notify the Surety of the actual cost of the remedy, upon completion of the remedy. The City shall return, without interest, any overpayment made by the Surety, and the Surety shall pay to the City any actual costs which exceeded the City estimate, limited to the bond amount.

2. In the event the Principal fails to make repairs or provide maintenance within the time period requested by the City, then the City, its employees and agents shall have the right at the City's sole election to enter onto said property described above for the purpose of repairing or maintaining the improvements. This provision shall not be construed as creating an obligation on the part of the City or its representatives to repair or maintain such improvements.

E. Corrections. Any corrections required by the City shall be commenced within ten (10) days of notification by the City and completed within thirty (30) days of the date of notification. If the work is not performed in a timely manner, the City shall have the right, without recourse to legal action, to take such action under this bond as described in Section D above.

F. Extensions and Changes. No change, extension of time, alteration or addition to the work to be performed by the Principal shall affect the obligation of the Principal or Surety on this bond, unless the City specifically agrees, in writing, to such alteration, addition, extension or change. The Surety waives notice of any such change, extension, alteration or addition thereunder.

G. Enforcement. It is specifically agreed by and between the parties that in the event any legal action must be taken to enforce the provisions of this bond or to collect said bond, the prevailing party shall be entitled to collect its costs and reasonable attorney fees as a part of the reasonable costs of securing the obligation hereunder. In the event of settlement or resolution of these issues prior to the filing of any suit, the actual costs incurred by the City, including reasonable attorney fees, shall be considered a part of the obligation hereunder secured. Said costs and reasonable legal fees shall be recoverable by the prevailing party, not only from the proceeds of this bond, but also over and above said bond as a part of any recovery (including recovery on the bond) in any judicial proceeding. The Surety hereby agrees that this bond shall be governed by the laws of the State of Washington. Venue of any litigation arising out of this bond shall be in Kitsap County Superior Court.

H. Bond Expiration. This bond shall remain in full force and effect until the obligations secured hereby have been fully performed and until released in writing by the City at the request of the Surety or Principal.

DATED this ____ day of _____, 20__.

SURETY COMPANY
(Signature must be notarized)

DEVELOPER/OWNER
(Signature must be notarized)

By: _____
Its: _____

By: _____
Its: _____

Business Name: _____

Business Name: _____

Business Address: _____

Business Address: _____

City/State/Zip Code: _____

City/State/Zip Code: _____

Telephone Number: _____

Telephone Number: _____

VIII.

CHECK FOR ATTACHED NOTARY SIGNATURE

____ Individual (Form P-1)
____ Corporation (Form P-2)
____ Surety Company (Form P-2)

APWA GENERAL SPECIAL PROVISIONS

INTRODUCTION TO THE SPECIAL PROVISIONS

(December 10, 2020 APWA GSP)

The work on this project shall be accomplished in accordance with the *Standard Specifications for Road, Bridge and Municipal Construction*, 2023 edition, as issued by the Washington State Department of Transportation (WSDOT) and the American Public Works Association (APWA), Washington State Chapter (hereafter "Standard Specifications"). The Standard Specifications, as modified or supplemented by these Special Provisions, all of which are made a part of the Contract Documents, shall govern all of the Work.

These Special Provisions are made up of both General Special Provisions (GSPs) from various sources, which may have project-specific fill-ins; and project-specific Special Provisions. Each Provision either supplements, modifies, or replaces the comparable Standard Specification, or is a new Provision. The deletion, amendment, alteration, or addition to any subsection or portion of the Standard Specifications is meant to pertain only to that particular portion of the section, and in no way should it be interpreted that the balance of the section does not apply.

The project-specific Special Provisions are not labeled as such. The GSPs are labeled under the headers of each GSP, with the effective date of the GSP and its source. For example:

(March 8, 2013 APWA GSP)

(April 1, 2013 WSDOT GSP)

Also incorporated into the Contract Documents by reference are:

- *Manual on Uniform Traffic Control Devices for Streets and Highways*, currently adopted edition, with Washington State modifications, if any
- *Standard Plans for Road, Bridge and Municipal Construction*, WSDOT/APWA, current edition
- *Standards and Specifications*, City of Port Orchard, currently adopted edition

Contractor shall obtain copies of these publications, at Contractor's own expense.

1-01.3 Definitions
(January 19, 2022 APWA GSP)

Delete the heading **Completion Dates** and the three paragraphs that follow it, and replace them with the following:

Dates

Bid Opening Date

The date on which the Contracting Agency publicly opens and reads the Bids.

Award Date

The date of the formal decision of the Contracting Agency to accept the lowest responsible and responsive Bidder for the Work.

Contract Execution Date

The date the Contracting Agency officially binds the Agency to the Contract.

Notice to Proceed Date

The date stated in the Notice to Proceed on which the Contract time begins.

Substantial Completion Date

The day the Engineer determines the Contracting Agency has full and unrestricted use and benefit of the facilities, both from the operational and safety standpoint, any remaining traffic disruptions will be rare and brief, and only minor incidental work, replacement of temporary substitute facilities, plant establishment periods, or correction or repair remains for the Physical Completion of the total Contract.

Physical Completion Date

The day all of the Work is physically completed on the project. All documentation required by the Contract and required by law does not necessarily need to be furnished by the Contractor by this date.

Completion Date

The day all the Work specified in the Contract is completed and all the obligations of the Contractor under the contract are fulfilled by the Contractor. All documentation required by the Contract and required by law must be furnished by the Contractor before establishment of this date.

Final Acceptance Date

The date on which the Contracting Agency accepts the Work as complete.

Supplement this Section with the following:

All references in the Standard Specifications or WSDOT General Special Provisions, to the terms "Department of Transportation", "Washington State Transportation Commission", "Commission", "Secretary of Transportation", "Secretary", "Headquarters", and "State Treasurer" shall be revised to read "Contracting Agency".

All references to the terms "State" or "state" shall be revised to read "Contracting Agency" unless the reference is to an administrative agency of the State of Washington, a State statute or regulation, or the context reasonably indicates otherwise.

All references to "State Materials Laboratory" shall be revised to read "Contracting Agency designated location".

All references to "final contract voucher certification" shall be interpreted to mean the Contracting Agency form(s) by which final payment is authorized, and final completion and acceptance granted.

Additive

A supplemental unit of work or group of bid items, identified separately in the Bid Proposal, which may, at the discretion of the Contracting Agency, be awarded in addition to the base bid.

Alternate

One of two or more units of work or groups of bid items, identified separately in the Bid Proposal, from which the Contracting Agency may make a choice between different methods or material of construction for performing the same work.

Business Day

A business day is any day from Monday through Friday except holidays as listed in Section 1-08.5.

Contract Bond

The definition in the Standard Specifications for "Contract Bond" applies to whatever bond form(s) are required by the Contract Documents, which may be a combination of a Payment Bond and a Performance Bond.

Contract Documents

See definition for "Contract".

Contract Time

The period of time established by the terms and conditions of the Contract within which the Work must be physically completed.

Notice of Award

The written notice from the Contracting Agency to the successful Bidder signifying the Contracting Agency's acceptance of the Bid Proposal.

Notice to Proceed

The written notice from the Contracting Agency or Engineer to the Contractor authorizing and directing the Contractor to proceed with the Work and establishing the date on which the Contract time begins.

Traffic

Both vehicular and non-vehicular traffic, such as pedestrians, bicyclists, wheelchairs, and equestrian traffic.

1-02 BID PROCEDURES AND CONDITIONS

1-02.1 Prequalification of Bidders

Delete this section and replace it with the following:

1-02.1 Qualifications of Bidder

(January 24, 2011 APWA GSP)

Before award of a public works contract, a bidder must meet at least the minimum qualifications of RCW 39.04.350(1) to be considered a responsible bidder and qualified to be awarded a public works project.

1-02.2 Plans and Specifications

(June 27, 2011 APWA GSP)

Delete this section and replace it with the following:

Information as to where Bid Documents can be obtained or reviewed can be found in the Call for Bids (Advertisement for Bids) for the work.

After award of the contract, plans and specifications will be issued to the Contractor at no cost as detailed below:

To Prime Contractor	No. of Sets	Basis of Distribution
Reduced plans (11" x 17")	2	Furnished automatically upon award.
Contract Provisions	2	Furnished automatically upon award.
Large plans (e.g., 22" x 34")	1	Furnished only upon request.

Additional plans and Contract Provisions may be obtained by the Contractor from the source stated in the Call for Bids, at the Contractor's own expense.

1-02.5 Proposal Forms
(July 31, 2017 APWA GSP)

Delete this section and replace it with the following:

The Proposal Form will identify the project and its location and describe the work. It will also list estimated quantities, units of measurement, the items of work, and the materials to be furnished at the unit bid prices. The bidder shall complete spaces on the proposal form that call for, but are not limited to, unit prices; extensions; summations; the total bid amount; signatures; date; and, where applicable, retail sales taxes and acknowledgment of addenda; the bidder's name, address, telephone number, and signature; the bidder's UDBE/DBE/M/WBE commitment, if applicable; a State of Washington Contractor's Registration Number; and a Business License Number, if applicable. Bids shall be completed by typing or shall be printed in ink by hand, preferably in black ink. The required certifications are included as part of the Proposal Form.

The Contracting Agency reserves the right to arrange the proposal forms with alternates and additives, if such be to the advantage of the Contracting Agency. The bidder shall bid on all alternates and additives set forth in the Proposal Form unless otherwise specified.

1-02.7 Bid Deposit
(March 8, 2013 APWA GSP)

Supplement this section with the following:

Bid bonds shall contain the following:

1. Contracting Agency-assigned number for the project;
2. Name of the project;
3. The Contracting Agency named as obligee;
4. The amount of the bid bond stated either as a dollar figure or as a percentage which represents five percent of the maximum bid amount that could be awarded;
5. Signature of the bidder's officer empowered to sign official statements. The signature of the person authorized to submit the bid should agree with the signature on the bond, and the title of the person must accompany the said signature;
6. The signature of the surety's officer empowered to sign the bond and the power of attorney.

If so stated in the Contract Provisions, bidder must use the bond form included in the Contract Provisions.

If so stated in the Contract Provisions, cash will not be accepted for a bid deposit.

1-02.9 Delivery of Proposal

(January 19, 2022 APWA GSP, Option A)

Delete this section and replace it with the following:

Each Proposal shall be submitted in a sealed envelope, with the Project Name and Project Number as stated in the Call for Bids clearly marked on the outside of the envelope, or as otherwise required in the Bid Documents, to ensure proper handling and delivery.

To be considered responsive on a FHWA-funded project, the Bidder may be required to submit the following items, as required by Section 1-02.6:

- DBE Utilization Certification (WSDOT 272-056)
- DBE Written Confirmation Document (WSDOT 422-031) from each DBE firm listed on the Bidder's completed DBE Utilization Certification
- Good Faith Effort (GFE) Documentation
- DBE Bid Item Breakdown (WSDOT 272-054)
- DBE Trucking Credit Form (WSDOT 272-058)

DBE Utilization Certification

The DBE Utilization Certification shall be received at the same location and no later than the time required for delivery of the Proposal. The Contracting Agency will not open or consider any Proposal when the DBE Utilization Certification is received after the time specified for receipt of Proposals or received in a location other than that specified for receipt of Proposals. The DBE Utilization Certification may be submitted in the same envelope as the Bid deposit.

DBE Written Confirmation and/or GFE Documentation

The DBE Written Confirmation Documents and/or GFE Documents are not required to be submitted with the Proposal. The DBE Written Confirmation Document(s) and/or GFE (if any) shall be received either with the Bid Proposal or as a Supplement to the Bid. The documents shall be received no later than 48 hours (not including Saturdays, Sundays and Holidays) after the time for delivery of the Proposal. To be considered responsive, Bidders shall submit Written Confirmation Documentation from each DBE firm listed on the Bidder's completed DBE Utilization Certification and/or the GFE as required by Section 1-02.6.

DBE Bid Item Breakdown and DBE Trucking Credit Form

The DBE Bid Item Breakdown and the DBE Trucking Credit Forms (if applicable) shall be received either with the Bid Proposal or as a Supplement to the Bid. The documents shall be received no later than 48 hours (not including Saturdays, Sundays and Holidays) after the time for delivery of the Proposal. To be considered responsive, Bidders shall submit a completed DBE Bid Item Breakdown and a DBE Trucking Credit Form for each DBE Trucking firm listed on the DBE Utilization Certification, however, minor errors and corrections to DBE Bid Item Breakdown or DBE Trucking Credit Forms will be returned for correction for a period up to five calendar days (not including Saturdays, Sundays and Holidays) after the time for delivery of the Proposal. A DBE Bid Item Breakdown or DBE Trucking Credit Forms

that are still incorrect after the correction period will be determined to be non-responsive.

Proposals that are received as required will be publicly opened and read as specified in Section 1-02.12. The Contracting Agency will not open or consider any Bid Proposal that is received after the time specified in the Call for Bids for receipt of Bid Proposals, or received in a location other than that specified in the Call for Bids. The Contracting Agency will not open or consider any "Supplemental Information" (DBE confirmations, or GFE documentation) that is received after the time specified above, or received in a location other than that specified in the Call for Bids.

If an emergency or unanticipated event interrupts normal work processes of the Contracting Agency so that Proposals cannot be received at the office designated for receipt of bids as specified in Section 1-02.12 the time specified for receipt of the Proposal will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which the normal work processes of the Contracting Agency resume.

1-02.10 Withdrawing, Revising, or Supplementing Proposal
(July 23, 2015 APWA GSP)

Delete this section, and replace it with the following:

After submitting a physical Bid Proposal to the Contracting Agency, the Bidder may withdraw, revise, or supplement it if:

1. The Bidder submits a written request signed by an authorized person and physically delivers it to the place designated for receipt of Bid Proposals, and
2. The Contracting Agency receives the request before the time set for receipt of Bid Proposals, and
3. The revised or supplemented Bid Proposal (if any) is received by the Contracting Agency before the time set for receipt of Bid Proposals.

If the Bidder's request to withdraw, revise, or supplement its Bid Proposal is received before the time set for receipt of Bid Proposals, the Contracting Agency will return the unopened Proposal package to the Bidder. The Bidder must then submit the revised or supplemented package in its entirety. If the Bidder does not submit a revised or supplemented package, then its bid shall be considered withdrawn.

Late revised or supplemented Bid Proposals or late withdrawal requests will be date recorded by the Contracting Agency and returned unopened. Mailed, emailed, or faxed requests to withdraw, revise, or supplement a Bid Proposal are not acceptable.

1-02.13 Irregular Proposals
(December 30, 2022 APWA GSP)

Delete this section and replace it with the following:

1. A Proposal will be considered irregular and will be rejected if:
 - a. The Bidder is not prequalified when so required;
 - b. The authorized Proposal form furnished by the Contracting Agency is not used or is altered;
 - c. The completed Proposal form contains any unauthorized additions, deletions, alternate Bids, or conditions;
 - d. The Bidder adds provisions reserving the right to reject or accept the award, or enter into the Contract;
 - e. A price per unit cannot be determined from the Bid Proposal;
 - f. The Proposal form is not properly executed;
 - g. The Bidder fails to submit or properly complete a subcontractor list (WSDOT Form 271-015), if applicable, as required in Section 1-02.6;
 - h. The Bidder fails to submit or properly complete a Disadvantaged Business Enterprise Certification (WSDOT Form 272-056), if applicable, as required in Section 1-02.6;
 - i. The Bidder fails to submit Written Confirmations (WSDOT Form 422-031) from each DBE firm listed on the Bidder's completed DBE Utilization Certification that they are in agreement with the bidder's DBE participation commitment, if applicable, as required in Section 1-02.6, or if the written confirmation that is submitted fails to meet the requirements of the Special Provisions;
 - j. The Bidder fails to submit DBE Good Faith Effort documentation, if applicable, as required in Section 1-02.6, or if the documentation that is submitted fails to demonstrate that a Good Faith Effort to meet the Condition of Award was made;
 - k. The Bidder fails to submit a DBE Bid Item Breakdown (WSDOT Form 272-054), if applicable, as required in Section 1-02.6, or if the documentation that is submitted fails to meet the requirements of the Special Provisions;
 - l. The Bidder fails to submit DBE Trucking Credit Forms (WSDOT Form 272-058), if applicable, as required in Section 1-02.6, or if the documentation that is submitted fails to meet the requirements of the Special Provisions;
 - m. The Bid Proposal does not constitute a definite and unqualified offer to meet the material terms of the Bid invitation; or
 - n. More than one Proposal is submitted for the same project from a Bidder under the same or different names.

2. A Proposal may be considered irregular and may be rejected if:
 - a. The Proposal does not include a unit price for every Bid item;
 - b. Any of the unit prices are excessively unbalanced (either above or below the amount of a reasonable Bid) to the potential detriment of the Contracting Agency;
 - c. Receipt of Addenda is not acknowledged;

- d. A member of a joint venture or partnership and the joint venture or partnership submit Proposals for the same project (in such an instance, both Bids may be rejected); or
- e. If Proposal form entries are not made in ink.

1-02.14 Disqualification of Bidders
(May 17, 2018 APWA GSP, Option A)

Delete this section and replace it with the following:

A Bidder will be deemed not responsible if the Bidder does not meet the mandatory bidder responsibility criteria in RCW 39.04.350(1), as amended.

The Contracting Agency will verify that the Bidder meets the mandatory bidder responsibility criteria in RCW 39.04.350(1). To assess bidder responsibility, the Contracting Agency reserves the right to request documentation as needed from the Bidder and third parties concerning the Bidder's compliance with the mandatory bidder responsibility criteria.

If the Contracting Agency determines the Bidder does not meet the mandatory bidder responsibility criteria in RCW 39.04.350(1) and is therefore not a responsible Bidder, the Contracting Agency shall notify the Bidder in writing, with the reasons for its determination. If the Bidder disagrees with this determination, it may appeal the determination within two (2) business days of the Contracting Agency's determination by presenting its appeal and any additional information to the Contracting Agency. The Contracting Agency will consider the appeal and any additional information before issuing its final determination. If the final determination affirms that the Bidder is not responsible, the Contracting Agency will not execute a contract with any other Bidder until at least two business days after the Bidder determined to be not responsible has received the Contracting Agency's final determination.

1-02.15 Pre Award Information
(December 30, 2022 APWA GSP)

Revise this section to read:

Before awarding any contract, the Contracting Agency may require one or more of these items or actions of the apparent lowest responsible bidder:

1. A complete statement of the origin, composition, and manufacture of any or all materials to be used,
2. Samples of these materials for quality and fitness tests,
3. A progress schedule (in a form the Contracting Agency requires) showing the order of and time required for the various phases of the work,
4. A breakdown of costs assigned to any bid item,
5. Attendance at a conference with the Engineer or representatives of the Engineer,
6. Obtain, and furnish a copy of, a business license to do business in the city or county where the work is located.
7. Any other information or action taken that is deemed necessary to ensure that the bidder is the lowest responsible bidder.

1-03.1 Consideration of Bids
(December 30, 2022 APWA GSP)

Revise the first paragraph to read:

After opening and reading proposals, the Contracting Agency will check them for correctness of extensions of the prices per unit and the total price. If a discrepancy exists between the price per unit and the extended amount of any bid item, the price per unit will control. If a minimum bid amount has been established for any item and the bidder's unit or lump sum price is less than the minimum specified amount, the Contracting Agency will unilaterally revise the unit or lump sum price, to the minimum specified amount and recalculate the extension. The total of extensions, corrected where necessary, including sales taxes where applicable and such additives and/or alternates as selected by the Contracting Agency, will be used by the Contracting Agency for award purposes and to fix the Awarded Contract Price amount and the amount of the contract bond.

1-03.3 Execution of Contract
(January 19, 2022 APWA GSP)

Revise this section to read:

Within 3 calendar days of Award date (not including Saturdays, Sundays and Holidays), the successful Bidder shall provide the information necessary to execute the Contract to the Contracting Agency. The Bidder shall send the contact information, including the full name, email address, and phone number, for the authorized signer and bonding agent to the Contracting Agency.

Copies of the Contract Provisions, including the unsigned Form of Contract, will be available for signature by the successful bidder on the first business day following award. The number of copies to be executed by the Contractor will be determined by the Contracting Agency.

Within 14 calendar days after the award date, the successful bidder shall return the signed Contracting Agency-prepared contract, an insurance certification as required by Section 1-07.18, a satisfactory bond as required by law and Section 1-03.4, the Transfer of Coverage form for the Construction Stormwater General Permit with sections I, III, and VIII completed when provided. Before execution of the contract by the Contracting Agency, the successful bidder shall provide any pre-award information the Contracting Agency may require under Section 1-02.15.

Until the Contracting Agency executes a contract, no proposal shall bind the Contracting Agency nor shall any work begin within the project limits or within Contracting Agency-furnished sites. The Contractor shall bear all risks for any work begun outside such areas and for any materials ordered before the contract is executed by the Contracting Agency.

If the bidder experiences circumstances beyond their control that prevents return of the contract documents within the calendar days after the award date stated above, the Contracting Agency may grant up to a maximum of 14 additional calendar days for return of the documents, provided the Contracting Agency deems the circumstances warrant it.

1-03.4 Contract Bond

(July 23, 2015 APWA GSP)

Delete the first paragraph and replace it with the following:

The successful bidder shall provide executed payment and performance bond(s) for the full contract amount. The bond may be a combined payment and performance bond; or be separate payment and performance bonds. In the case of separate payment and performance bonds, each shall be for the full contract amount. The bond(s) shall:

1. Be on Contracting Agency-furnished form(s);
2. Be signed by an approved surety (or sureties) that:
 - a. Is registered with the Washington State Insurance Commissioner, and
 - b. Appears on the current Authorized Insurance List in the State of Washington published by the Office of the Insurance Commissioner,
3. Guarantee that the Contractor will perform and comply with all obligations, duties, and conditions under the Contract, including but not limited to the duty and obligation to indemnify, defend, and protect the Contracting Agency against all losses and claims related directly or indirectly from any failure:
 - a. Of the Contractor (or any of the employees, subcontractors, or lower tier subcontractors of the Contractor) to faithfully perform and comply with all contract obligations, conditions, and duties, or
 - b. Of the Contractor (or the subcontractors or lower tier subcontractors of the Contractor) to pay all laborers, mechanics, subcontractors, lower tier subcontractors, material person, or any other person who provides supplies or provisions for carrying out the work;
4. Be conditioned upon the payment of taxes, increases, and penalties incurred on the project under titles 50, 51, and 82 RCW; and
5. Be accompanied by a power of attorney for the Surety's officer empowered to sign the bond; and
6. Be signed by an officer of the Contractor empowered to sign official statements (sole proprietor or partner). If the Contractor is a corporation, the bond(s) must be signed by the president or vice president, unless accompanied by written proof of the authority of the individual signing the bond(s) to bind the corporation (i.e., corporate resolution, power of attorney, or a letter to such effect signed by the president or vice president).

1-04.2 Coordination of Contract Documents, Plans, Special Provisions, Specifications, and Addenda

(December 30, 2022 APWA GSP)

Revise the second paragraph to read:

Any inconsistency in the parts of the contract shall be resolved by following this order of precedence (e.g., 1 presiding over 2, 2 over 3, 3 over 4, and so forth):

1. Addenda,
2. Proposal Form,
3. Special Provisions,
4. Contract Plans,
5. Standard Specifications,
6. Contracting Agency's Standard Plans or Details (if any), and
7. WSDOT Standard Plans for Road, Bridge, and Municipal Construction.

1-04.4(1) Minor Changes
(May 30, 2019 APWA GSP)

Delete the first paragraph and replace it with the following:

Payments or credits for changes amounting to \$25,000 or less may be made under the Bid item "Minor Change". At the discretion of the Contracting Agency, this procedure for Minor Changes may be used in lieu of the more formal procedure as outlined in Section 1-04.4, Changes. All "Minor Change" work will be within the scope of the Contract Work and will not change Contract Time.

1-05.7 Removal of Defective and Unauthorized Work
(October 1, 2005 APWA GSP)

Supplement this section with the following:

If the Contractor fails to remedy defective or unauthorized work within the time specified in a written notice from the Engineer, or fails to perform any part of the work required by the Contract Documents, the Engineer may correct and remedy such work as may be identified in the written notice, with Contracting Agency forces or by such other means as the Contracting Agency may deem necessary.

If the Contractor fails to comply with a written order to remedy what the Engineer determines to be an emergency situation, the Engineer may have the defective and unauthorized work corrected immediately, have the rejected work removed and replaced, or have work the Contractor refuses to perform completed by using Contracting Agency or other forces. An emergency situation is any situation when, in the opinion of the Engineer, a delay in its remedy could be potentially unsafe, or might cause serious risk of loss or damage to the public.

Direct or indirect costs incurred by the Contracting Agency attributable to correcting and remedying defective or unauthorized work, or work the Contractor failed or refused to perform, shall be paid by the Contractor. Payment will be deducted by the Engineer from monies due, or to become due, the Contractor. Such direct and indirect costs shall include in particular, but without limitation, compensation for additional professional services required, and costs for repair and replacement of work of others destroyed or damaged by correction, removal, or replacement of the Contractor's unauthorized work.

No adjustment in contract time or compensation will be allowed because of the delay in the performance of the work attributable to the exercise of the Contracting Agency's rights provided by this Section.

The rights exercised under the provisions of this section shall not diminish the Contracting Agency's right to pursue any other avenue for additional remedy or damages with respect to the Contractor's failure to perform the work as required.

1-05.11 Final Inspection

Delete this section and replace it with the following:

1-05.11 Final Inspections and Operational Testing *(October 1, 2005 APWA GSP)*

1-05.11(1) Substantial Completion Date

When the Contractor considers the work to be substantially complete, the Contractor shall so notify the Engineer and request the Engineer establish the Substantial Completion Date. The Contractor's request shall list the specific items of work that remain to be completed in order to reach physical completion. The Engineer will schedule an inspection of the work with the Contractor to determine the status of completion. The Engineer may also establish the Substantial Completion Date unilaterally.

If, after this inspection, the Engineer concurs with the Contractor that the work is substantially complete and ready for its intended use, the Engineer, by written notice to the Contractor, will set the Substantial Completion Date. If, after this inspection the Engineer does not consider the work substantially complete and ready for its intended use, the Engineer will, by written notice, so notify the Contractor giving the reasons therefor.

Upon receipt of written notice concurring in or denying substantial completion, whichever is applicable, the Contractor shall pursue vigorously, diligently and without unauthorized interruption, the work necessary to reach Substantial and Physical Completion. The Contractor shall provide the Engineer with a revised schedule indicating when the Contractor expects to reach substantial and physical completion of the work.

The above process shall be repeated until the Engineer establishes the Substantial Completion Date and the Contractor considers the work physically complete and ready for final inspection.

1-05.11(2) Final Inspection and Physical Completion Date

When the Contractor considers the work physically complete and ready for final inspection, the Contractor by written notice, shall request the Engineer to schedule a final inspection. The Engineer will set a date for final inspection. The Engineer and the Contractor will then make a final inspection and the Engineer will notify the Contractor in writing of all particulars in which the final inspection reveals the work incomplete or unacceptable. The Contractor shall immediately take such corrective measures as are necessary to remedy the listed deficiencies. Corrective work shall be pursued vigorously, diligently, and without interruption until physical completion of the listed deficiencies. This process will continue until the Engineer is satisfied the listed deficiencies have been corrected.

If action to correct the listed deficiencies is not initiated within 7 days after receipt of the written notice listing the deficiencies, the Engineer may, upon written notice to

the Contractor, take whatever steps are necessary to correct those deficiencies pursuant to Section 1-05.7.

The Contractor will not be allowed an extension of contract time because of a delay in the performance of the work attributable to the exercise of the Engineer's right hereunder.

Upon correction of all deficiencies, the Engineer will notify the Contractor and the Contracting Agency, in writing, of the date upon which the work was considered physically complete. That date shall constitute the Physical Completion Date of the contract, but shall not imply acceptance of the work or that all the obligations of the Contractor under the contract have been fulfilled.

1-05.11(3) Operational Testing

It is the intent of the Contracting Agency to have at the Physical Completion Date a complete and operable system. Therefore when the work involves the installation of machinery or other mechanical equipment; street lighting, electrical distribution or signal systems; irrigation systems; buildings; or other similar work it may be desirable for the Engineer to have the Contractor operate and test the work for a period of time after final inspection but prior to the physical completion date. Whenever items of work are listed in the Contract Provisions for operational testing they shall be fully tested under operating conditions for the time period specified to ensure their acceptability prior to the Physical Completion Date. During and following the test period, the Contractor shall correct any items of workmanship, materials, or equipment which prove faulty, or that are not in first class operating condition. Equipment, electrical controls, meters, or other devices and equipment to be tested during this period shall be tested under the observation of the Engineer, so that the Engineer may determine their suitability for the purpose for which they were installed. The Physical Completion Date cannot be established until testing and corrections have been completed to the satisfaction of the Engineer.

The costs for power, gas, labor, material, supplies, and everything else needed to successfully complete operational testing, shall be included in the unit contract prices related to the system being tested, unless specifically set forth otherwise in the proposal.

Operational and test periods, when required by the Engineer, shall not affect a manufacturer's guaranties or warranties furnished under the terms of the contract.

Add the following new section:

1-05.16 Water and Power
(October 1, 2005 APWA GSP)

The Contractor shall make necessary arrangements, and shall bear the costs for power and water necessary for the performance of the work, unless the contract includes power and water as a pay item.

Add the following new section:

1-05.18 Record Drawings
(March 8, 2013 APWA GSP)

The Contractor shall maintain one set of full size plans for Record Drawings, updated with clear and accurate red-lined field revisions on a daily basis, and within 2 business days after receipt of information that a change in Work has occurred. The Contractor shall not conceal any work until the required information is recorded.

This Record Drawing set shall be used for this purpose alone, shall be kept separate from other Plan sheets, and shall be clearly marked as Record Drawings. These Record Drawings shall be kept on site at the Contractor's field office, and shall be available for review by the Contracting Agency at all times. The Contractor shall bring the Record Drawings to each progress meeting for review.

The preparation and upkeep of the Record Drawings is to be the assigned responsibility of a single, experienced, and qualified individual. The quality of the Record Drawings, in terms of accuracy, clarity, and completeness, is to be adequate to allow the Contracting Agency to modify the computer-aided drafting (CAD) Contract Drawings to produce a complete set of Record Drawings for the Contracting Agency without further investigative effort by the Contracting Agency.

The Record Drawing markups shall document all changes in the Work, both concealed and visible. Items that must be shown on the markups include but are not limited to:

- Actual dimensions, arrangement, and materials used when different than shown in the Plans.
- Changes made by Change Order or Field Order.
- Changes made by the Contractor.
- Accurate locations of storm sewer, sanitary sewer, water mains and other water appurtenances, structures, conduits, light standards, vaults, width of roadways, sidewalks, landscaping areas, building footprints, channelization and pavement markings, etc. Include pipe invert elevations, top of castings (manholes, inlets, etc.).

If the Contract calls for the Contracting Agency to do all surveying and staking, the Contracting Agency will provide the elevations at the tolerances the Contracting Agency requires for the Record Drawings.

When the Contract calls for the Contractor to do the surveying/staking, the applicable tolerance limits include, but are not limited to the following:

	Vertical	Horizontal
As-built sanitary & storm invert and grate elevations	± 0.01 foot	± 0.01 foot
As-built monumentation	± 0.001 foot	± 0.001 foot
As-built waterlines, inverts, valves, hydrants	± 0.10 foot	± 0.10 foot

As-built ponds/swales/water features	± 0.10 foot	± 0.10 foot
As-built buildings (fin. Floor elev.)	± 0.01 foot	± 0.10 foot
As-built gas lines, power, TV, Tel, Com	± 0.10 foot	± 0.10 foot
As-built signs, signals, etc.	N/A	± 0.10 foot

Making Entries on the Record Drawings:

- Use erasable colored pencil (not ink) for all markings on the Record Drawings, conforming to the following color code:
- Additions - Red
- Deletions - Green
- Comments - Blue
- Dimensions- Graphite
- Provide the applicable reference for all entries, such as the change order number, the request for information (RFI) number, or the approved shop drawing number.
- Date all entries.
- Clearly identify all items in the entry with notes similar to those in the Contract Drawings (such as pipe symbols, centerline elevations, materials, pipe joint abbreviations, etc.).

The Contractor shall certify on the Record Drawings that said drawings are an accurate depiction of built conditions, and in conformance with the requirements detailed above. The Contractor shall submit final Record Drawings to the Contracting Agency. Contracting Agency acceptance of the Record Drawings is one of the requirements for achieving Physical Completion.

Payment will be made for the following bid item:

Record Drawings (Minimum Bid \$ 0)	Lump Sum
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Payment for this item will be made on a prorated monthly basis for work completed in accordance with this section up to 75% of the lump sum bid. The final 25% of the lump sum item will be paid upon submittal and approval of the completed Record Drawings set prepared in conformance with these Special Provisions.

A minimum bid amount has been entered in the Bid Proposal for this item. The Contractor must bid at least that amount.

1-07.1 Laws to be Observed

(October 1, 2005 APWA GSP)

Supplement this section with the following:

In cases of conflict between different safety regulations, the more stringent regulation shall apply.

The Washington State Department of Labor and Industries shall be the sole and paramount administrative agency responsible for the administration of the provisions of the Washington Industrial Safety and Health Act of 1973 (WISHA).

The Contractor shall maintain at the project site office, or other well known place at the project site, all articles necessary for providing first aid to the injured. The Contractor shall establish, publish, and make known to all employees, procedures for ensuring immediate removal to a hospital, or doctor's care, persons, including employees, who may have been injured on the project site. Employees should not be permitted to work on the project site before the Contractor has established and made known procedures for removal of injured persons to a hospital or a doctor's care.

The Contractor shall have sole responsibility for the safety, efficiency, and adequacy of the Contractor's plant, appliances, and methods, and for any damage or injury resulting from their failure, or improper maintenance, use, or operation. The Contractor shall be solely and completely responsible for the conditions of the project site, including safety for all persons and property in the performance of the work. This requirement shall apply continuously, and not be limited to normal working hours. The required or implied duty of the Engineer to conduct construction review of the Contractor's performance does not, and shall not, be intended to include review and adequacy of the Contractor's safety measures in, on, or near the project site.

1-07.2 State Taxes

Delete this section, including its sub-sections, in its entirety and replace it with the following:

1-07.2 State Sales Tax

(June 27, 2011 APWA GSP)

The Washington State Department of Revenue has issued special rules on the State sales tax. Sections 1-07.2(1) through 1-07.2(3) are meant to clarify those rules. The Contractor should contact the Washington State Department of Revenue for answers to questions in this area. The Contracting Agency will not adjust its payment if the Contractor bases a bid on a misunderstood tax liability.

The Contractor shall include all Contractor-paid taxes in the unit bid prices or other contract amounts. In some cases, however, state retail sales tax will not be included. Section 1-07.2(2) describes this exception.

The Contracting Agency will pay the retained percentage (or release the Contract Bond if a FHWA-funded Project) only if the Contractor has obtained from the Washington State Department of Revenue a certificate showing that all contract-related taxes have been paid (RCW 60.28.051). The Contracting Agency may deduct from its payments to the Contractor any amount the Contractor may owe the Washington State Department of Revenue, whether the amount owed relates to this contract or not. Any amount so deducted will be paid into the proper State fund.

1-07.2(1) State Sales Tax — Rule 171

WAC 458-20-171, and its related rules, apply to building, repairing, or improving streets, roads, etc., which are owned by a municipal corporation, or political subdivision of the state, or by the United States, and which are used primarily for foot or vehicular traffic. This includes storm or combined sewer systems within and included as a part of the street or road drainage system and power lines when such are part of the roadway lighting system. For work performed in such cases, the Contractor shall include Washington State Retail Sales Taxes in the various unit bid item prices, or other contract amounts, including those that the Contractor pays on the purchase of the materials, equipment, or supplies used or consumed in doing the work.

1-07.2(2) State Sales Tax — Rule 170

WAC 458-20-170, and its related rules, apply to the constructing and repairing of new or existing buildings, or other structures, upon real property. This includes, but is not limited to, the construction of streets, roads, highways, etc., owned by the state of Washington; water mains and their appurtenances; sanitary sewers and sewage disposal systems unless such sewers and disposal systems are within, and a part of, a street or road drainage system; telephone, telegraph, electrical power distribution lines, or other conduits or lines in or above streets or roads, unless such power lines become a part of a street or road lighting system; and installing or attaching of any article of tangible personal property in or to real property, whether or not such personal property becomes a part of the realty by virtue of installation.

For work performed in such cases, the Contractor shall collect from the Contracting Agency, retail sales tax on the full contract price. The Contracting Agency will automatically add this sales tax to each payment to the Contractor. For this reason, the Contractor shall not include the retail sales tax in the unit bid item prices, or in any other contract amount subject to Rule 170, with the following exception.

Exception: The Contracting Agency will not add in sales tax for a payment the Contractor or a subcontractor makes on the purchase or rental of tools, machinery, equipment, or consumable supplies not integrated into the project. Such sales taxes shall be included in the unit bid item prices or in any other contract amount.

1-07.2(3) Services

The Contractor shall not collect retail sales tax from the Contracting Agency on any contract wholly for professional or other services (as defined in Washington State Department of Revenue Rules 138 and 244).

1-07.18 Public Liability and Property Damage Insurance

Delete this section in its entirety, and replace it with the following:

1-07.18 Insurance

(December 30, 2022 APWA GSP)

1-07.18(1) General Requirements

- A. The Contractor shall procure and maintain the insurance described in all subsections of section 1-07.18 of these Special Provisions, from insurers with a current A. M. Best rating of not less than A-: VII and licensed to do business in the State of Washington. The Contracting Agency reserves the right to approve or reject the insurance provided, based on the insurer's financial condition.
- B. The Contractor shall keep this insurance in force without interruption from the commencement of the Contractor's Work through the term of the Contract and for thirty (30) days after the Physical Completion date, unless otherwise indicated below.
- C. If any insurance policy is written on a claims-made form, its retroactive date, and that of all subsequent renewals, shall be no later than the effective date of this Contract. The policy shall state that coverage is claims made and state the retroactive date. Claims-made form coverage shall be maintained by the Contractor for a minimum of 36 months following the Completion Date or earlier termination of this Contract, and the Contractor shall annually provide the Contracting Agency with proof of renewal. If renewal of the claims made form of coverage becomes unavailable, or economically prohibitive, the Contractor shall purchase an extended reporting period ("tail") or execute another form of guarantee acceptable to the Contracting Agency to assure financial responsibility for liability for services performed.
- D. The Contractor's Automobile Liability, Commercial General Liability and Excess or Umbrella Liability insurance policies shall be primary and non-contributory insurance as respects the Contracting Agency's insurance, self-insurance, or self-insured pool coverage. Any insurance, self-insurance, or self-insured pool coverage maintained by the Contracting Agency shall be excess of the Contractor's insurance and shall not contribute with it.
- E. The Contractor shall provide the Contracting Agency and all additional insureds with written notice of any policy cancellation, within two business days of their receipt of such notice.
- F. The Contractor shall not begin work under the Contract until the required insurance has been obtained and approved by the Contracting Agency
- G. Failure on the part of the Contractor to maintain the insurance as required shall constitute a material breach of contract, upon which the Contracting Agency may, after giving five business days' notice to the Contractor to correct the breach, immediately terminate the Contract or, at its discretion, procure or renew such insurance and pay any and all premiums in connection therewith, with any sums so expended to be repaid to the Contracting Agency on demand, or at the sole discretion of the Contracting Agency, offset against funds due the Contractor from the Contracting Agency.

H. All costs for insurance shall be incidental to and included in the unit or lump sum prices of the Contract and no additional payment will be made.

1-07.18(2) Additional Insured

All insurance policies, with the exception of Workers Compensation, and of Professional Liability and Builder's Risk (if required by this Contract) shall name the following listed entities as additional insured(s) using the forms or endorsements required herein:

- the Contracting Agency and its officers, elected officials, employees, agents, and volunteers

The above-listed entities shall be additional insured(s) for the full available limits of liability maintained by the Contractor, irrespective of whether such limits maintained by the Contractor are greater than those required by this Contract, and irrespective of whether the Certificate of Insurance provided by the Contractor pursuant to 1-07.18(4) describes limits lower than those maintained by the Contractor.

For Commercial General Liability insurance coverage, the required additional insured endorsements shall be at least as broad as ISO forms CG 20 10 10 01 for ongoing operations and CG 20 37 10 01 for completed operations.

1-07.18(3) Subcontractors

The Contractor shall cause each subcontractor of every tier to provide insurance coverage that complies with all applicable requirements of the Contractor-provided insurance as set forth herein, except the Contractor shall have sole responsibility for determining the limits of coverage required to be obtained by subcontractors.

The Contractor shall ensure that all subcontractors of every tier add all entities listed in 1-07.18(2) as additional insureds, and provide proof of such on the policies as required by that section as detailed in 1-07.18(2) using an endorsement as least as broad as ISO CG 20 10 10 01 for ongoing operations and CG 20 37 10 01 for completed operations.

Upon request by the Contracting Agency, the Contractor shall forward to the Contracting Agency evidence of insurance and copies of the additional insured endorsements of each subcontractor of every tier as required in 1-07.18(4) Verification of Coverage.

1-07.18(4) Verification of Coverage

The Contractor shall deliver to the Contracting Agency a Certificate(s) of Insurance and endorsements for each policy of insurance meeting the requirements set forth herein when the Contractor delivers the signed Contract for the work. Failure of Contracting Agency to demand such verification of coverage with these insurance requirements or failure of Contracting Agency to identify a deficiency from the insurance documentation provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

Verification of coverage shall include:

1. An ACORD certificate or a form determined by the Contracting Agency to be equivalent.
2. Copies of all endorsements naming Contracting Agency and all other entities listed in 1-07.18(2) as additional insured(s), showing the policy number. The Contractor may

submit a copy of any blanket additional insured clause from its policies instead of a separate endorsement.

3. Any other amendatory endorsements to show the coverage required herein.
4. A notation of coverage enhancements on the Certificate of Insurance shall not satisfy these requirements – actual endorsements must be submitted.

Upon request by the Contracting Agency, the Contractor shall forward to the Contracting Agency a full and certified copy of the insurance policy(s). If Builders Risk insurance is required on this Project, a full and certified copy of that policy is required when the Contractor delivers the signed Contract for the work.

1-07.18(5) Coverages and Limits

The insurance shall provide the minimum coverages and limits set forth below. Contractor's maintenance of insurance, its scope of coverage, and limits as required herein shall not be construed to limit the liability of the Contractor to the coverage provided by such insurance, or otherwise limit the Contracting Agency's recourse to any remedy available at law or in equity.

All deductibles and self-insured retentions must be disclosed and are subject to approval by the Contracting Agency. The cost of any claim payments falling within the deductible or self-insured retention shall be the responsibility of the Contractor. In the event an additional insured incurs a liability subject to any policy's deductibles or self-insured retention, said deductibles or self-insured retention shall be the responsibility of the Contractor.

1-07.18(5)A Commercial General Liability

Commercial General Liability insurance shall be written on coverage forms at least as broad as ISO occurrence form CG 00 01, including but not limited to liability arising from premises, operations, stop gap liability, independent contractors, products-completed operations, personal and advertising injury, and liability assumed under an insured contract. There shall be no exclusion for liability arising from explosion, collapse or underground property damage.

The Commercial General Liability insurance shall be endorsed to provide a per project general aggregate limit, using ISO form CG 25 03 05 09 or an equivalent endorsement.

Contractor shall maintain Commercial General Liability Insurance arising out of the Contractor's completed operations for at least three years following Substantial Completion of the Work.

Such policy must provide the following minimum limits:

\$3,000,000	Each Occurrence
\$3,000,000	General Aggregate
\$3,000,000	Products & Completed Operations Aggregate
\$1,000,000	Personal & Advertising Injury each offence
\$1,000,000	Stop Gap / Employers' Liability each accident

1-07.18(5)B Automobile Liability

Automobile Liability shall cover owned, non-owned, hired, and leased vehicles; and shall be written on a coverage form at least as broad as ISO form CA 00 01. If the work involves the transport of pollutants, the automobile liability policy shall include MCS 90 and CA 99 48 endorsements.

Such policy must provide the following minimum limit:

\$1,000,000 Combined single limit each accident

1-07.18(5)C Workers' Compensation

The Contractor shall comply with Workers' Compensation coverage as required by the Industrial Insurance laws of the State of Washington.

1-07.23(1) Construction Under Traffic
(May 2, 2017 APWA GSP)

Revise the third sentence of the second paragraph to read:

Accessibility to existing or temporary pedestrian push buttons shall not be impaired; if approved by the Contracting Agency activating pedestrian recall timing or other accommodation may be allowed during construction.

1-07.24 Rights of Way
(July 23, 2015 APWA GSP)

Delete this section and replace it with the following:

Street Right of Way lines, limits of easements, and limits of construction permits are indicated in the Plans. The Contractor's construction activities shall be confined within these limits, unless arrangements for use of private property are made.

Generally, the Contracting Agency will have obtained, prior to bid opening, all rights of way and easements, both permanent and temporary, necessary for carrying out the work. Exceptions to this are noted in the Bid Documents or will be brought to the Contractor's attention by a duly issued Addendum.

Whenever any of the work is accomplished on or through property other than public Right of Way, the Contractor shall meet and fulfill all covenants and stipulations of any easement agreement obtained by the Contracting Agency from the owner of the private property. Copies of the easement agreements may be included in the Contract Provisions or made available to the Contractor as soon as practical after they have been obtained by the Engineer.

Whenever easements or rights of entry have not been acquired prior to advertising, these areas are so noted in the Plans. The Contractor shall not proceed with any portion of the work in areas where right of way, easements or rights of entry have not been acquired until the Engineer certifies to the Contractor that the right of way or easement is available or that the right of entry has been received. If the Contractor is delayed due to acts of omission on the part of the Contracting Agency in obtaining easements, rights of entry or right of way, the Contractor will be entitled to an extension of time. The Contractor agrees that such delay shall not be a breach of contract.

Each property owner shall be given 48 hours notice prior to entry by the Contractor. This includes entry onto easements and private property where private improvements must be adjusted.

The Contractor shall be responsible for providing, without expense or liability to the Contracting Agency, any additional land and access thereto that the Contractor may desire for temporary construction facilities, storage of materials, or other Contractor needs. However, before using any private property, whether adjoining the work or not, the Contractor shall file with the Engineer a written permission of the private property owner, and, upon vacating the premises, a written release from the property owner of each property disturbed or otherwise interfered with by reasons of construction pursued under this contract. The statement shall be signed by the private property owner, or proper authority acting for the owner of the private property affected, stating that permission has been granted to use the property and all necessary permits have been obtained or, in the case of a release, that the restoration of the property has been satisfactorily accomplished. The statement shall include the parcel number, address, and date of signature. Written releases must be filed with the Engineer before the Completion Date will be established.

1-08 PROSECUTION AND PROGRESS

Add the following new section:

1-08.0 Preliminary Matters
(May 25, 2006 APWA GSP)

Add the following new section:

1-08.0(1) Preconstruction Conference

(October 10, 2008 APWA GSP)

Prior to the Contractor beginning the work, a preconstruction conference will be held between the Contractor, the Engineer and such other interested parties as may be invited. The purpose of the preconstruction conference will be:

1. To review the initial progress schedule;
2. To establish a working understanding among the various parties associated or affected by the work;
3. To establish and review procedures for progress payment, notifications, approvals, submittals, etc.;
4. To establish normal working hours for the work;
5. To review safety standards and traffic control; and
6. To discuss such other related items as may be pertinent to the work.

The Contractor shall prepare and submit at the preconstruction conference the following:

1. A breakdown of all lump sum items;
2. A preliminary schedule of working drawing submittals; and
3. A list of material sources for approval if applicable.

1-08.1 Subcontracting

(December 30, 2022 APWA GSP, Option A)

Section 1-08.1 is supplemented with the following:

Prior to any subcontractor or lower tier subcontractor beginning work, the Contractor shall submit to the Engineer a certification (WSDOT Form 420-004) that a written agreement between the Contractor and the subcontractor or between the subcontractor and any lower tier subcontractor has been executed. This certification shall also guarantee that these subcontract agreements include all the documents required by the Special Provision Federal Agency Inspection.

A subcontractor or lower tier subcontractor will not be permitted to perform any work under the contract until the following documents have been completed and submitted to the Engineer:

1. Request to Sublet Work (WSDOT Form 421-012), and
2. Contractor and Subcontractor or Lower Tier Subcontractor Certification for Federal-aid Projects (WSDOT Form 420-004).

The Contractor shall submit to the Engineer a completed Monthly Retainage Report (WSDOT Form 272-065) within 15 calendar days after receipt of every monthly progress payment until every subcontractor and lower tier subcontractor's retainage has been released.

The Contractor's records pertaining to the requirements of this Special Provision shall be open to inspection or audit by representatives of the Contracting Agency during the life of the contract and for a period of not less than three years after the date of acceptance of the contract. The Contractor shall retain these records for that period. The Contractor shall also guarantee that these records of all subcontractors and lower tier subcontractors shall be available and open to similar inspection or audit for the same time period.

1-08.3(2)A Type A Progress Schedule
(December 30, 2022 APWA GSP)

Revise this section to read:

The Contractor shall submit 5 copies of a Type A Progress Schedule no later than at the preconstruction conference, or some other mutually agreed upon submittal time. The schedule may be a critical path method (CPM) schedule, bar chart, or other standard schedule format. Regardless of which format used, the schedule shall identify the critical path. The Engineer will evaluate the Type A Progress Schedule and approve or return the schedule for corrections within 15 calendar days of receiving the submittal.

1-08.4 Prosecution of Work

Delete this section and replace it with the following:

1-08.4 Notice to Proceed and Prosecution of Work

(July 23, 2015 APWA GSP)

Notice to Proceed will be given after the contract has been executed and the contract bond and evidence of insurance have been approved and filed by the Contracting Agency. The Contractor shall not commence with the work until the Notice to Proceed has been given by the Engineer. The Contractor shall commence construction activities on the project site within ten days of the Notice to Proceed Date, unless otherwise approved in writing. The Contractor shall diligently pursue the work to the physical completion date within the time specified in the contract. Voluntary shutdown or slowing of operations by the Contractor shall not relieve the Contractor of the responsibility to complete the work within the time(s) specified in the contract.

When shown in the Plans, the first order of work shall be the installation of high visibility fencing to delineate all areas for protection or restoration, as described in the Contract. Installation of high visibility fencing adjacent to the roadway shall occur after the placement of all necessary signs and traffic control devices in accordance with 1-10.1(2). Upon construction of the fencing, the Contractor shall request the Engineer to inspect the fence. No other work shall be performed on the site until the Contracting Agency has accepted the installation of high visibility fencing, as described in the Contract.

1-09.6 Force Account

(December 30, 2022 APWA GSP)

Supplement this section with the following:

The Contracting Agency has estimated and included in the Proposal, dollar amounts for all items to be paid per force account, only to provide a common proposal for Bidders. All such dollar amounts are to become a part of Contractor's total bid. However, the Contracting Agency does not warrant expressly or by implication, that the actual amount of work will correspond with those estimates. Payment will be made on the basis of the amount of work actually authorized by the Engineer.

1-09.7 Mobilization

(December 30, 2022 APWA GSP)

Delete this Section and replace it with the following:

Mobilization consists of preconstruction expenses and the costs of preparatory Work and operations performed by the Contractor typically occurring before 10 percent of the total original amount of an individual Bid Schedule is earned from other Contract items on that Bid Schedule. Items which are not to be included in the item of Mobilization include but are not limited to:

1. Portions of the Work covered by the specific Contract item or incidental Work which is to be included in a Contract item or items.
2. Profit, interest on borrowed money, overhead, or management costs.
3. Costs incurred for mobilizing equipment for force account Work.

Based on the lump sum Contract price for "Mobilization", partial payments will be made as follows:

1. When 5 percent of the total original Bid Schedule amount is earned from other Contract items on that original Bid Schedule, excluding amounts paid for materials on hand, 50 percent of the Bid Item for mobilization on that original Bid Schedule, 5 percent of the total of that original Bid Schedule, or 5 percent of the total original Contract amount, whichever is the least, will be paid.
2. When 10 percent of the total original Bid Schedule amount is earned from other Contract items on that original Bid Schedule, excluding amounts paid for materials on hand, 100 percent of the Bid Item for mobilization on that original Bid Schedule, 10 percent of the total of that original Bid Schedule, or 10 percent of the total original Contract amount, whichever is the least, will be paid.
3. When the Substantial Completion Date has been established for the project, payment of any remaining amount Bid for mobilization will be paid.

Nothing herein shall be construed to limit or preclude partial payments otherwise provided by the Contract.

TECHNICAL SPECIFICATIONS

DIVISION 01 – GENERAL REQUIREMENTS

**SECTION 01 10 00
SUMMARY OF WORK**

PART 1 GENERAL

This Summary of Work supplements and amplifies certain sections of the General Conditions and Supplementary General Conditions. The General Conditions and Supplementary General Conditions shall apply except as modified herein. These Special Provisions and additional technical specifications may contain occasional requirements not pertinent to the Project. However, these specifications shall apply in all particulars insofar as they are applicable to this Project.

1.1 APPLICABLE STANDARD SPECIFICATIONS AND PLANS

The City of Port Orchard Public Works Engineering Standards (including all revisions at date of bid opening), apply except as may be modified herein. In the case of discrepancy, unless noted otherwise herein, the more restrictive provisions shall apply.

1.2 DWSRF FUNDING REQUIREMENTS

American Iron and Steel

This provision applies to projects for the construction, alteration, maintenance, or repair of a public water system as defined in the Safe Drinking Water Act (42 U.S.C 300j-12). This provision does not apply if the Department of Health approved the engineering plans and specification for the project prior to January 17, 2014.

The contractor acknowledges to and for the benefit of the project owner and Washington State that she or he understands that the Drinking Water State Revolving Loan Fund is paying for the goods and services under this agreement. DWSRF contains provisions, commonly known as "Buy American;" that requires all iron and steel products used in the project be produced in the United States (American Iron and Steel Requirements). The act defines iron and steel products as, "...the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials."

The contractor hereby represents and warrants to and for the benefit of the project owner and the state that:

- A. The contractor has reviewed and understands the American Iron and Steel Requirements,
- B. All of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirements, unless a waiver of the requirements is approved, and

- C. The contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirements, as may be requested by the project owner or the state.

Notwithstanding any other provisions of this agreement, any failure to comply with this paragraph by the contractor shall permit the project owner or state to recover as damages against the contractor any loss, expense or cost (including without limitation attorney's fees) incurred by the project owner or state resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or part, from the state or any damages owed to the state by the project owner). While the contractor has no direct contractual obligation with the state, as a lender to the project owner for the funding of its project, the project owner and the contractor agree that the state is a third-party beneficiary and neither this paragraph nor any other provision of the agreement necessary to give this paragraph force or effect shall be amended or waived without the prior written consent of the state.

Small, minority and women-owned firms should be afforded the maximum opportunity to compete for and obtain bid documents for DWSRF-funded projects. The level of participation by small, minority and women-owned firms should be consistent with their general availability within the professional community involved.

1.3 SCOPE OF WORK

The work to be performed under these specifications and drawings consists of various site improvements to the well field of the McCormick Woods water system, a public water system that currently consists of four wells designated Well 1, Well 2, Well 3, and McCormick Woods Well 11. Work includes, but is not limited to, the following:

- D. Installation of a 1,250-gpm submersible pump with variable frequency drive at Well 11. Decommissioning of Wells 1 and 2 and conversion of Well 3 to a monitoring well;
- E. Installation of a 1,250-gpm booster pumping system;
- F. Demolition of an existing booster pump station;
- G. Construction of a new approximately 3,000 square-foot booster pump and treatment CMU building;
- H. Installation of a sodium hypochlorite disinfection system and a sodium fluoride fluoridation system;
- I. Conversion of two existing 60,000-gallon storage tanks to contact clearwells including cleaning, coating, and equipment replacement;
- J. Yard piping modifications;

- K. 600 ft sewer main extension;
- L. Site clearing, grading, and paving;
- M. Installation of new generator set;
- N. Electrical and controls work.

The above general outline of principal features of the work does not in any way limit the responsibility of the Contractor(s) to perform all work and furnish all equipment, labor and materials required by the specifications and drawings. The drawings and specifications shall be considered and used together. Anything appearing as a requirement of either shall be accepted as applicable to both even though not so stated therein or shown.

No attempt has been made in these specifications or drawings to segregate work covered by any trade or subcontract under one specification. Such segregation and establishment of subcontract limits will be solely a matter of specific agreement between the Contractor and its subcontractors and shall not be based upon any inclusion, segregation, or arrangement in or of these specifications.

1.4 COORDINATION OF DRAWINGS AND SPECIFICATIONS

The drawings and specifications are intended to describe and provide for a complete work. Any requirement in one is as binding as if stated in all. The Contractor shall provide any work or materials clearly implied in the Contract Documents even if the Contract Documents do not mention it specifically. If there is a conflict within the Contract Documents, it will be resolved by the following order of precedence:

- A. Permits for outside agencies required by law
- B. Contract Agreement
- C. Addenda to Contract Documents
- D. Contractor's Proposal
- E. Contract Drawings
- F. Technical Specifications
- G. City of Port Orchard Public Works Engineering Standards
- H. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction

Dimensions shown on the drawings or that can be computed shall take precedence over scaled dimensions. Notes on drawings are part of the drawings and govern in the order described above. Notes on drawings shall take precedence over drawing details.

The intent of the drawings and specifications is to prescribe the details for the construction and completion of the work which the Contractor undertakes to perform according to the terms of the Contract. Where the drawings or specifications describe portions of the work in general terms, but details are incomplete or silent, it is understood that only the best general practice is to prevail and that only materials and workmanship of the best quality are to be used. Unless otherwise specified, the Contractor shall furnish all labor, materials, tools, equipment, and incidentals, and do all the work involved in executing the Contract in a manner satisfactory to the Engineer.

The contract drawings are designated by general title, sheet number and sheet title. When reference is made to the drawings, the "Sheet Number" of the drawing will be used. Each drawing bears the Engineer's File No. 20-2839.01 and the general title:

MCCORMICK WOODS – WELL NO. 11 SITE IMPROVEMENT PROJECT

The specific titles of each sheet are contained on Sheet G-1 of the drawings.

1.5 CODE REQUIREMENTS

All work shall be done in strict compliance with the requirements of:

- A. 2018 International Building Code
- B. 2018 International Mechanical Code
- C. 2018 Uniform Plumbing Code
- D. National Electric Code
- E. National Electric Safety Code
- F. Washington State Department of Labor and Industries
- G. City of Port Orchard Public Works Engineering Standards

In case of disagreement between codes or these specifications, the more restrictive shall prevail.

1.6 TIME OF COMPLETION/LIQUIDATED DAMAGES

The Contractor shall complete all work shown and specified within the time limits stated in the Contract. The written Notice to Proceed will be sent to the Contractor after the Contractor submits the signed Contract, Bonds and insurance certificates to the Owner and those documents have been approved as to form and executed by the Owner. The Contractor's attention is directed to the Contract and the General Conditions as respects liquidated damages.

1.7 COORDINATION WITH OTHER CONTRACTORS AND WITH OWNER

Certain work within this contract may require connection to and coordination with the work of other contractors and Owner. The Contractor under these specifications shall cooperate fully with all other contractors and Owner and carefully fit its own work to such other work as may be directed by the Engineer. The Contractor shall not commit or permit any act to be committed which will interfere with the performance of work by any other contractor or the Owner.

1.8 ACCESS TO WORK

Access to the work shall be provided as may be required by the Owner or its representatives, and all authorized representatives of the state and federal governments and any other agencies having jurisdiction over any phase of the work, for inspection of the progress of the work, the methods of construction or any other required purposes.

1.9 PERMITS AND LICENSES

Unless provided for otherwise in these contract documents, all permits, licenses, and fees shall be obtained by the Contractor and all costs shall be borne by the Contractor. Contractor shall pay all plan check fees and other fees necessary to obtain permits and shall accommodate special inspections required thereof. Contractor shall be responsible for compliance with all permit provisions and shall accommodate all special inspections required thereof, all at no additional expense to the Owner beyond prices as bid.

1.10 SITE INVESTIGATION AND PHYSICAL DATA

The Contractor acknowledges that it is satisfied as to the nature and location of the work and the general and local conditions, including but not limited to those bearing upon transportation, disposal, handling and storage of materials, availability of water, roads, groundwater, access to the sites, coordination with other contractors, and conflicts with pipelines, structures, and other contractors. Information and data furnished or referred to herein is furnished for information only. Any failure by the Contractor to become acquainted with the available information and existing conditions will not be a basis for relief from successfully performing the work and will not constitute justification for additional compensation.

The Contractor shall verify the locations and elevations of existing pipelines, structures, grades, and utilities, prior to construction. The Owner assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available.

1.11 TEMPORARY UTILITIES FOR CONSTRUCTION PURPOSES

The Contractor shall make all arrangements necessary to provide all temporary utilities for construction purposes and shall pay all costs associated those temporary utilities. Water for

construction purposes will be furnished by the Owner at no cost. The Contractor shall furnish all valves, hoses, connections, and other devices as necessary to obtain enough water for construction and for filling and testing of water lines as required. Fire hydrant use is allowed only by permission of the utility owner. Backflow protection is required on all connections to potable water systems.

1.12 FIELD SERVICE BY MANUFACTURER'S REPRESENTATIVE

The Contractor shall furnish the services of a manufacturer's or material supplier's representative for all major equipment and materials furnished by the Contractor or Owner under this contract, to check, place in operation and test the installation, and train operating personnel. The manufacturer's representative shall be qualified and authorized to perform repairs and maintenance on the equipment. The above gives a general scope of the services desired from the manufacturer's representative. It will be the responsibility of the Contractor and the equipment manufacturer to determine detailed requirements. Costs for services of the manufacturer's representative shall be included in the proposal of the Contractor. The operator training mentioned above shall include enough time during the Contractor's operation and testing period to fully explain to the operating personnel the features of the equipment and maintenance thereof.

1.13 CONSTRUCTION WITHIN PUBLIC RIGHTS-OF-WAY

When the work contemplated is wholly or partly within the right-of-way of a public agency such as a city, county or state, the Owner will obtain from these agencies any right-of-way and street opening permits and all other necessary permit(s) required for the work. The Contractor shall abide by all regulations and conditions stipulated in the permit(s). Such conditions and requirements are hereby made a part of these specifications, as fully and completely as though the same were fully set forth herein. The Contractor shall examine the permit(s) granted to the Owner by any city, county, state, and federal agencies. Failure to do so will not relieve the Contractor from compliance with the requirements stated therein.

The Contractor shall obtain all construction permits and pay all fees or charges and furnish any bonds and insurance coverages as necessary to ensure that all requirements of the city, county, state, or federal agencies will be observed, and the roadway and ditches are restored to their original condition or one equally satisfactory. A copy of all permits shall be kept on the work site for use of the Engineer.

1.14 PRIVATE ROADS AND DRIVEWAYS

Bridges at entrances to business properties where vehicular traffic is necessary shall be provided and maintained. Bridges shall be adequate in width and strength for the service required. No private road or driveway may be closed without approval of the Engineer unless written authority has been given by the owner whose property has been affected. Driveways shall be left open and ready for use at the end of the work shift. All expenses involved in providing for construction, maintenance, and use of private roads or driveways, shall be

borne by the Contractor and the amount thereof absorbed in the unit prices of the Contractor's bid.

1.15 TRAFFIC CONTROL AND PROTECTION

The Contractor shall maintain traffic control and protection in the work areas 24 hours per day. Traffic control shall conform to the standards set forth in the **"Washington Manual on Uniform Traffic Control Devices" issued by the Washington Department of Transportation.**

The Contractor shall conduct its operations to keep one lane of traffic open for public and private access at all times on City, County and Public streets, roads, and highways. If required by the State, the Contractor shall conduct its operations to keep both directions of traffic open on State Highways. Permits obtained for the Project may have more stringent requirements than noted in this section.

Prior to beginning construction, the Contractor shall submit a detailed street closure and traffic control plan to the Engineer for approval. As construction proceeds, the Contractor shall notify the Engineer as to the status of street closures and detours.

On streets where traffic is heavy, the Engineer may require the construction of two-way bridges of adequate design. These bridges shall be provided with guard rails and shall be well lighted at all times. Detours as required by the Engineer shall be surfaced with gravel or crushed rock and maintained in good condition. Detours for pedestrians shall not exceed one block in length, and foot bridges over the trenches shall be provided with adequate handrails.

All work shall be carried on with due regard for safety to the public. Open trenches shall be provided with barricades of a type that can be seen at a reasonable distance, and at night they shall be distinctly indicated by adequately placed lights.

1.16 MATERIALS AND COMPACTION TESTING

The City will provide Special Inspections including compaction testing under the building. The Contractor shall provide the services of a licensed, independent agency to perform materials and compaction testing for trenching and paving associated with this Project. The agency must be approved by the Engineer. Materials and compaction tests will be required to show that specified densities of compacted backfill and asphaltic concrete surfacing are being achieved by the Contractor's compaction methods. The Contractor shall provide the Engineer with copies of recent Proctor tests for the backfill and paving material in addition to copies of compaction tests performed in the field.

After the Engineer is satisfied that the Contractor's method of compaction consistently meets specified compaction requirements, the testing frequency may be reduced. The Engineer may direct testing at a higher frequency upon failure to obtain specified densities

or if the Contractor changes compaction equipment or methods of compaction. All test locations shall be determined by the Engineer.

1.17 DECHLORINATION AND DISPOSAL OF CHLORINATED WATER

No chlorinated water shall be discharged into the storm drainage system prior to approved de-chlorination treatment. Any discharge of chlorinated water to a public sanitary sewer system shall require explicit approval from the City.

1.18 LIMITS OF THE WORK AND STORAGE OF SPOILS

The limits of the site which may be used for construction, storage, materials handling, parking of vehicles and other operations related to the Project include the Project site as shown on the drawings and adjacent public rights-of-way subject to permission of the public owner of that right-of-way. The limits of work also include rights of access obtained by the Contractor, subject to all public laws and regulations and rights of access by utility companies and other holders of easement rights.

1.19 EXISTING WATER SYSTEM SHUTDOWN

If the Project involves the need to shut down an existing water system, the Contractor shall coordinate the work to insure a minimum of shutdown time. The Contractor shall submit a written shutdown schedule to the Engineer for approval. The Contractor shall provide 72-hour notice preceding each shutdown.

1.20 FIELD CHANGES, ALIGNMENT, AND GRADE

Changes of alignment and grade shall be made during the course of work in order to avoid interference with unforeseen obstructions. The Contractor shall locate existing utilities to be crossed, by potholing ahead of the pipe installation, of sufficient distance to avoid conflicts through pipe joint deflection if possible. All costs for minor field changes of alignment and grade shall be borne by the Contractor. The Engineer will endeavor to make prompt decisions on such matters. Contractor shall anticipate a minimum of 72 hours for any decision requiring significant piping change.

1.21 TESTING AND OPERATION OF FACILITIES

It is the intent of the Owner to have a complete and operable facility. All the work under this contract will be fully tested and inspected in accordance with the specifications. Upon completion of the work, the Contractor shall operate the completed facilities as required to test the equipment under the direction of the Engineer. During this period of operation by the Contractor, the new facilities will be tested thoroughly to determine their acceptance.

1.22 PROTECTION OF EXISTING STRUCTURES AND WORK

The Contractor must take all precautions and measures necessary to protect all existing structures and work. Any damage to existing structures and work shall be repaired by removing the damaged structure or work, replacing the work, and restoring to original condition satisfactory to the Engineer.

1.23 SALVAGE AND DEBRIS

Unless otherwise indicated on the drawings or in the specifications, all castings, pipe, equipment, demolition debris, spoil or any other discarded material or equipment shall become the property of the Contractor and shall be disposed of in a manner compliant with applicable Federal, State, and local laws and regulations governing disposal of such waste products. No burning of debris or any other discarded material will be permitted.

1.24 SAFETY STANDARDS AND ACCIDENT PREVENTION

The Contractor shall be solely and completely responsible for conditions of the job site, including safety of all persons and property during performance of the work. This requirement shall apply continuously and not be limited to normal working hours. The required and/or implied duty of the Engineer to conduct construction review of the Contractor's performance does not, and is not intended to, include review of the adequacy of the Contractor's safety measures in, on, or near the construction site.

The Contractor shall comply with the safety standards provisions of applicable laws and building and construction codes. The Contractor shall exercise every precaution at all times for the prevention of accidents and protection of persons, including employees, and property. During the execution of the work the Contractor shall provide and maintain all guards, railing, lights, warnings, and other protective devices which are required by law, or which are reasonably necessary for the protection of persons and property from injury or damage.

1.25 PUBLIC SAFETY AND CONVENIENCE

General Rule: The Contractor shall ensure the safety of the public during its performance of the Work and shall minimize any public inconvenience in addition to any other requirement imposed by law. These duties include, but are not limited to, the matters listed below.

Access: The Contractor shall not unreasonably restrict access to public facilities, commercial property, fire hydrants, residential property, and other areas where the public can be expected to be present, such as sidewalks and streets without first obtaining approval of the Owner. Driveways shall be closed only with the approval of the Owner or after obtaining specific permission from the property owner or owners. In addition, the Contractor shall not obstruct or interfere with travel over any public street or sidewalk without approval of the Owner.

Public Transit: The Contractor shall not interfere with the normal operation of any public transit vehicles unless otherwise authorized.

Work Site: The Contractor shall keep the Project site safe in compliance with applicable law. Safety includes, but is not limited to: 1) providing an approved type of secured and adequate barricades or fences that are easily visible from a reasonable distance around open excavations; 2) closing up or covering with steel plates all open excavations at the end of each Working Day in all street areas and in all other areas when it is reasonably required for public safety; 3) marking all open work and obstructions by lights at night; 4) installing and maintaining all necessary signs, lights, flares, barricades, railings, runways, stairs, bridges, and facilities; 5) observing any and all safety instructions received from the Owner; and 6) following all laws and regulations concerning worker and public safety. In the event that the law requires greater safety obligations than that imposed by the Owner, the Contractor shall comply with the law.

Emergency: Emergency vehicles, including but not limited to police, fire, and disaster units shall be provided access to the work site at all times.

Cleanliness: The Contractor shall, on a continuing basis, keep the surfaces of all public and private roadways, sidewalks, and other pathways free of dirt, mud, cold plane grindings, and other matters that the Contractor may place upon the road. The cost of performing such work shall be included in the Contractor's Bid and no additional payment will be made for performing this task.

Parking: The Contractor shall make any necessary contacts with all applicable governmental bodies to arrange for the removal of parked automobiles, vehicles, and other obstructions if they would interfere with the performance of the Contractor's work.

Accidents: The Contractor's Project Manager or superintendent shall be in charge of accident prevention. Contractor shall take all actions necessary to prevent damage, injury and loss to persons and property as a result of accidents.

Project Health and Safety Plan: Contractor shall develop, publish, and implement an overall Project Health and Safety Program for the Project. This Program shall conform to all applicable codes. Contractor shall submit the written Safety Program to the Owner within 30 days after the receipt of the written Notice to Proceed. The Plan shall be assembled to address project specific health and safety issues to both the public and on-site personnel. The plan shall include the following items when they apply:

- Employee Orientation
- Safety Inspections
- Instruction and Training
- Accident Reporting
- Signs and Barricades
- Hazardous Materials
- Hazardous Communications Program
- Job Hazard Analysis
- First Aid/Medical Facilities
- Personal Protective Equipment

- Fire Prevention and Protection
- Welding, Cutting, and Burning
- Painting and Surface Treatment
- Electricity
- Machinery and Mechanized Equipment
- Excavations
- Sanitation
- Chlorine Safety
- Confined Space Entry Plan
- Shoring Plan
- Fall Protection Plan
- Emergency Action Plan
- Housekeeping
- Safety Training Requirements and Certification
- Pedestrian Access Around Work Site During Construction and After Hours

If the Project requires other health and safety issues to be addressed, they too shall be included in the Project Health and Safety Plan. The Program shall subsequently be distributed to and implemented by the Contractor's personnel as well as its Subcontractors and Suppliers. Contractor shall fully implement and comply with the Safety Program and shall submit to the Owner a letter signed by Contractor's owner/president affirming such implementation and compliance within 15 days after on-site work has started. Contractor shall notify the Owner when safety meeting will be held so that Owner's personnel may attend. A copy of the approved Health and Safety Plan must be maintained on-site at all times during the life of the Project.

The Owner has no responsibility for Work site safety. Work site safety is the responsibility of the Contractor. The Contractor is required to have a competent person on site at all times during construction activities.

The Contractor shall provide signs on work zone fencing that provide information regarding access to businesses and stating that such businesses are open and in operation. The Contractor shall furnish and install the signs and provide sign attachments for the various business names.

1.26 WARRANTY PERIOD

The Contractor shall warrant all furnished materials and equipment for a period of two years from date of final acceptance of the Work by the Owner unless specified otherwise in the Contract Documents. This warranty shall mean prompt attention to the correction and/or complete replacement of the faulty material or equipment. The expiration of the warranty period shall not affect any other claims or remedy available to the Owner. There may be other warranty provisions in these contract documents in addition to those noted above.

1.27 UTILITY PROPERTIES AND SERVICE

In areas where the Contractor's operations are adjacent to or near a utility and such operations may cause damage which might result in significant expense, loss and

inconvenience, the operations shall be suspended until all arrangements necessary for the protection thereof have been made by the Contractor.

The Contractor shall notify all utility offices which may be affected by the construction operation at least 48 hours in advance. Before exposing any utility, the utility having jurisdiction shall grant permission and may oversee the operation. Should service of any utility be interrupted due to the Contractor's operation, the proper authority shall be notified immediately. It is of the utmost importance that the Contractor cooperates with the said authority in restoring the service as promptly as possible. Any costs shall be borne by the Contractor.

Utilities which may be impacted include the following:

City of Port Orchard	Water, Sanitary Sewer, Storm Drain
Cascade Natural Gas	Natural Gas
Puget Sound Energy	Power

1.28 SANITARY FACILITIES

The Contractor shall provide and maintain sanitary facilities for its employees and its subcontractors' employees that will comply with the regulations of the local and State Departments of Health and as directed by the Engineer.

1.29 STREET CLEANUP

The Contractor shall clean daily all dirt, gravel, construction debris, and other foreign material resulting from its operations from all streets and roads.

1.30 VEHICLE PARKING

The vehicles of the Contractor's and subcontractors' employees shall be parked in accordance with local parking ordinances.

1.31 PROTECTION OF QUALITY OF WATER

The work to be performed may involve connections to an existing potable water system. If such work is included in the Project, the Contractor shall take such precautions as are necessary or as may be required to prevent the contamination of the water. Such contamination may include but shall not be limited to deleterious chemicals such as fuel, cleaning agents, paint, demolition and construction debris, sandblasting residue, etc. In the event contamination does occur, the Contractor shall, at its own expense, perform such work as may be necessary to repair any damage or to clean the affected areas of the water mains to a condition satisfactory to the Engineer.

The work to be performed involves the excavation, cutting, removal and modifications to an existing well casing(s). All work required under this contract shall be performed in

accordance with **Washington Administrative Code of the Washington State Department of Ecology, Chapter 173, including but not limited to WAC 173-160, Minimum Standards for Construction and Maintenance of Wells and WAC 173-162, Regulation and Licensing of Well Contractors and Operators.**

1.32 RECORD DRAWINGS

Contractor shall maintain at the site one set of specifications, full size drawings, shop drawings, equipment drawings, and supplemental drawings which shall be corrected as the work progresses to show all changes made. Drawings shall be available for inspection by the Engineer. Upon completion of the contract and prior to final payment, specifications and drawings shall be turned over to the Engineer.

1.33 "OR EQUAL" CLAUSE

In order to establish a basis of quality, certain processes, types of machinery and equipment or kinds of material may be specified on the drawings or herein by designating a manufacturer's name and referring to its brand or product designation. It is not the intent of these specifications to exclude other processes, equipment or materials of a type and quality equal to those designated. When a manufacturer's name, brand, or item designation is given, it shall be understood that the words "or equal" follow such name or designation, whether in fact they do so or not. If the Contractor desires to furnish items of equipment by manufacturers other than those specified, the Contractor shall secure the approval of the Engineer prior to placing a purchase order.

No extras will be allowed the Contractor for any changes required to adopt the substitute equipment. Therefore, the Contractor's proposal for an alternate shall include all costs for any modifications to the drawings, such as structural and foundation changes, additional piping or changes in piping, electrical changes or any other modifications which may be necessary or required for approval and adoption of the proposed alternate equipment. Approval of alternate equipment by the Engineer before or after bidding does not guarantee or imply that the alternate equipment will fit the design without modifications.

1.34 SURVEYS

Based upon the information provided by the Contract Documents, the Contractor shall develop and make all detail surveys necessary for layout and construction, including exact component location, working points, lines, and elevations. Prior to construction, the field layout shall be approved by the Owner's representative. The Contractor shall have the responsibility to carefully preserve benchmarks, reference points, and stakes, and in the case of destruction thereof by the Contractor or resulting from its negligence, the Contractor shall be charged with the expense and damage resulting therefore and shall be responsible for any mistakes that may be caused by the unnecessary loss or disturbance of such benchmarks, reference points, and stakes.

1.35 WORK HOUR LIMITATIONS

All work shall be conducted between the hours of 7:00 a.m. and 6:00 p.m. on non-holiday weekdays only. No weekend work will be allowed. Requests for variations in work hours shall be made in writing for consideration by the Engineer. No work shall be conducted outside of the above-described days and hours without prior approval of the Engineer.

1.36 DUST PREVENTION

All unpaved streets, roads, detours, haul roads, or other areas where dust may be generated shall receive an approved dust-preventive treatment or be routinely watered to prevent dust. Applicable environmental regulations for dust prevention shall be strictly enforced.

Dust emissions from tank construction activities including sandblasting and painting shall be controlled to be within applicable environmental regulations. The Contractor shall be responsible for cleaning and repair of properties near the tank site which may become damaged by sandblasting or painting emissions.

1.37 EROSION AND SEDIMENTATION CONTROL

Temporary construction site erosion control measures shall be designed and constructed in accordance with the City of Port Orchard Stormwater Manual.

Erosion control measures shall be maintained throughout the Project Site until approved permanent cover such as a healthy stand of grass, other permanent vegetation, or other ground covering is established. When approved permanent ground cover is established, all temporary erosion control measures shall be removed from the construction site. Erosion control measures shall be installed as approved, per the erosion control drawing(s) in the above referenced document. Erosion control measures including stabilized construction entrances and sediment barriers must be established in conjunction with site clearing and grading.

During construction, and until permanent vegetation or other ground covering is established, the erosion control facilities shall be upgraded as needed for unexpected storm events or site conditions and with the purpose of retaining sediment and sediment-laden water on the construction site.

1.38 INTERFERENCES, OBSTRUCTIONS, AND SEWER CROSSINGS

At certain places, power, light, and telephone poles may interfere with excavation and the operation of the Contractor's equipment. Necessary arrangements shall be made with utility companies for moving or maintaining such poles. The utility company affected by any such interferences shall be notified thereof so that the necessary moving or proper care of poles and appurtenances may have appropriate attention.

All costs resulting from any other interferences and obstructions, or the replacement of such, whether or not herein specifically mentioned, shall be included and absorbed in the unit prices of the Contractor's bid.

1.39 NOISE LIMITATIONS

The Project areas are located within a residential zoned area. All applicable City, County ordinances, and State and Federal regulations shall be complied with.

1.40 STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. Materials and equipment stored overnight shall be placed neatly on the job site. Unusable materials (i.e., rejected or damaged liner material, old concrete chunks, metal scraps, etc.) shall be expeditiously removed from the job site.

Provide appropriate barricades, signs, and traffic control devices in like-new condition where necessary to protect the public from any hazards associated with the storage of materials and equipment used for this Project.

B. No equipment and/or materials shall be stored outside the immediate work area on public right-of-ways, in the following locations, or in the following manner:

1. In any maintained landscaped or lawn area.
2. In a manner that would totally eliminate an individual residents' street parking.
3. In front of any business.

The "immediate work area" is the area where work is taking place or will be taking place within one calendar day. The Contractor shall immediately move stored material or equipment which causes a nuisance or creates complaints.

1.41 COMPETENT PERSON DESIGNATION

Contractor shall designate a qualified and experienced "competent person" at the site whose duties and responsibilities shall include enforcement of applicable OSHA regulations regarding excavations, the prevention of accidents, and the maintenance and supervision of construction site safety precautions and programs.

1.42 EMERGENCY MAINTENANCE SUPERVISOR

The Contractor shall submit to the Engineer the names, addresses, and telephone numbers of at least two employees responsible for performing emergency maintenance and repairs when the Contractor is not working. These employees shall be designated, in writing by the Contractor, to act as its representatives and shall have full authority to act on its behalf. At

least one of the designated employees shall be available for a telephone call any time an emergency arises.

1.43 PREVAILING WAGE RATES FOR PUBLIC WORKS CONTRACTS IN WASHINGTON

The Contractor shall abide by **Chapter 39.12 RCW** which relate to the prevailing wage rates for the building and construction trades in the State of Washington and Federal Wage Rates in accordance with the Davis-Bacon Act. Refer to the DWSRF Borrowers Handbook included in the appendices. These prevailing wage rates are shown in the Department of Labor and Industries document which is available here: <https://lni.wa.gov/licensing-permits/public-works-projects/prevailing-wage-rates/>

1.44 USE OF EXPLOSIVES

The use of explosives shall not be allowed on this Project. Alternative methods of excavation shall be utilized.

1.45 CONTAMINATED MATERIAL

A. General

It is possible that the Contractor may encounter contaminated material (soil and/or water) during excavation activities. This specification identifies requirements for handling and disposing contaminated media.

B. Definitions

1. "Contaminated material" is defined as soil, water, free product, Underground Storage Tanks (UST), buried abandoned utility lines containing residual or free product, solid waste, treated wood waste, chemical containers, or other solid, liquid, or gas substances with contamination levels above background levels.
2. "Hazardous substances" shall mean those substances or materials defined in the WAC 173-340-200, as amended.
3. "Release" shall have the meaning as defined in WAC 173-340-200, as amended.
4. "Environmental laws" shall mean any applicable statute, law, ordinance, order, consent decree, judgment, permit, license, code, covenant, deed, common law, treaty, convention, or other requirement pertaining to protection of the environment, health or safety, natural resources, conservation, wildlife, waste management or disposal, hazardous substances, or pollution, including but not limited to regulation of releases to air, land, water, and groundwater.

C. Execution

1. Discovery of Contaminated Material

In the event that the Contractor, during the course of construction or during any other activities authorized under this contract, should encounter suspected contaminated material or any other materials suspected of posing a threat to human health and the environment, the Contractor shall notify the Engineer immediately and manage according to requirements identified below.

2. Discovery of Contaminated Soil

Contractor shall note evidence of contamination (odor, visual staining of soil, free liquid product seeping from soil, sheen on groundwater, etc.) and note location of evidence on a sketch of the excavation and provide to the Engineer.

Contractor shall report the discovery to the Engineer immediately. Contractor shall stop all excavation activities and secure the site to prevent entry by the public. The excavation shall not be backfilled. Protect all open excavations with berms, plates, and fencing. Contractor may continue with work in other non-contaminated areas.

Contractor shall assist Engineer in collecting sample(s) of suspected contaminated media for testing and characterization. Contractor shall allow 21 days, at no cost to Owner, for testing, results, and instructions as to how to proceed with contaminated materials.

The Contractor shall obtain a copy of an approved soil disposal/acceptance permit (Disposal/Treatment Facility requires transporter to have a copy of the permit.)

Contractor will transport and dispose of contaminated material at an approved disposal/treatment facility.

Contractor shall provide the Engineer with a copy of the contaminated soil disposal receipt.

3. Handling of Contaminated Soil

After approval from the Engineer, excavate the soil in a manner that prevents commingling of contaminated and non-contaminated soil. Engineer will make determination (based on soil saturation) if contaminated soil can be directly transported to a treatment or disposal facility, or if soil needs to be stockpiled to reduce water content. Engineer will determine when stockpiled soil can be transported off-site.

Contractor will be responsible for stockpiling contaminated soil in containers or on impervious surface to prevent the spread of contamination. Any water runoff from the contaminated soil stockpile area(s) must be contained by Contractor and handled as contaminated water.

Minimize movement of excavation equipment over or through contaminated soil to prevent movement of contaminated soil into areas where no contaminated soil exists.

Stockpiles will be created on an approved site and shall be surrounded by a fence to limit access. The stockpiles must be covered and bermed during periods of rainfall to prevent run-on and run-off. The stockpiles shall be covered with a minimum 10-mil high density polyethylene (HDPE) plastic during periods of strong winds, nightfall, over the weekends, or during extended work stoppages. If dust is observed coming from the stockpiles, the stockpiles shall be either covered or the dust controlled with water.

Maintain excavation equipment in good working order. Prevent spillage of oil, fuel, or hazardous substances from equipment. In particular, promptly repair oil leaks from equipment and clean up any contaminated soil.

4. Transport of Contaminated Materials

Contractor shall comply with all applicable Federal, State, or local laws, codes, and ordinances that govern or regulate contaminated substance transportation. Contaminated soils placed in stockpiles shall be loaded into trucks in a manner that prevents the spilling or tracking of contaminated soil into areas of the site with uncontaminated soil. Loose material falling onto the exterior of the truck during loading shall be removed before the truck leaves the loading area. Any material collected in the loading area shall either be placed back into the truck or back into the stockpile. If loading areas are unpaved, the surface soil shall be sampled at the conclusion of the loading activities to confirm that contaminated soil is not present. If loading areas are paved, any loose soil shall be cleaned from the pavement at the conclusion of the loading activities.

Specific truck haul routes shall be established before beginning off-site contaminated media transport. On-site truck routes shall be established to minimize or prevent movement of trucks over contaminated soils. Off-site truck routes shall be established to reduce the risk of releases of contaminated soils and impact on local traffic. The Contractor shall be responsible for ensuring that loaded truck weights are within acceptable limits. All trucks shall be covered before they leave the loading area.

The Contractor shall ensure that all drivers of vehicles transporting contaminated substances have in their possession during transport all applicable Washington State and local vehicle insurance requirements, valid driver's license, and vehicle registration and license. The Contractor shall be responsible for informing all drivers of transport vehicle about:

- a. The nature of the material transported.

- b. Required routes to and from the off-site thermal treatment or disposal facility.
- c. Applicable County street regulations and requirements, and State of Washington Department of Transportation codes, regulations, and requirements.
- d. The County's requirement for proper handling and transportation of the substances.

The Contractor shall not allow contaminated substances to be spilled or tracked off-site at any time during the Project. Trucks used for the transportation of contaminated substances off-site shall be watertight, substance compatible, licensed, insured, and permitted pursuant to federal, state, and local statutes, rules, regulations, and ordinances.

If contaminated media is discarded prior to removal of contaminated material, the price per cubic yard of soil materials and price per 100 gallons of contaminated water will be negotiated with Owner.

1.46 SEQUENCE OF CONSTRUCTION REQUIREMENTS

In order to meet the objectives of this Project, certain elements of work must be completed in accordance with Section 01 12 16.

1.47 INADVERTENT DISCOVERY PLAN FOR CULTURAL RESOURCES

If any archaeological or historical materials are encountered during project activity or construction, work in the immediate area (initially allowing for a 100-foot buffer; this may vary according to circumstances) must stop and the Contractor must take the following actions:

1. Implement reasonable measures to protect the discovery site, including any appropriate stabilization or covering.
2. Take reasonable steps to ensure the confidentiality of the discovery site.
3. Take reasonable steps to restrict access to the site of discovery.

The Contractor shall immediately notify the Engineer, which in turn will notify the concerned Tribes and all appropriate County, State, and Federal Agencies, including the Department of Archaeology and Historic Preservation (DAHP). The agencies and Tribe(s) will discuss possible measures to remove or avoid cultural material and will reach an agreement with the project proponent regarding actions to be taken and disposition of material.

If human remains are uncovered, the Contractor shall immediately notify the appropriate law enforcement agencies, the Engineer, and follow the above steps. If the remains are determined

to be Native, consultation with the affected Tribe(s) will take place in order to mitigate the final disposition of said remains.

The Contractor shall adhere to all applicable state laws and statutes per The Revised Code of Washington, Chapter 27.53, "Archaeological Sites and Resources" and Washington State Executive Order 05-05, "Archaeological and Cultural Resources". Additional state and federal law(s) may also apply.

END OF SECTION

**SECTION 01 12 16
WORK SEQUENCE**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes general sequencing, project phasing and coordination requirements for the Work.
- B. Contract Requirements:
 - 1. The existing McCormick Woods water system currently provides drinking water supply to the McCormick Woods development. The functions of the system shall not be compromised during the course of the Work, except as may be specified herein. Plan and prosecute the Work such that the operation of the McCormick Woods water system is not interrupted, expect as specified herein.
 - 2. Owner may determine the order of precedence and the time and season at which any portion or portions of the Work shall be commenced and carried on in order to ensure proper completion of the Contract, proper operation of the water system or compliance with DOH Permit conditions.

1.2 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Work Sequencing Plan: At a minimum, to include the following:
 - 1. Complete sequence of construction for all activities contained herein.
 - 2. Major work activities to occur.
 - 3. Schedule of temporary shutdowns of water service and estimated duration of shutdowns to facilitate connections to new facilities.
 - 4. Assistance to be required of Owner's operating personnel during shutdowns.
 - 5. Contingency plan identifying what action will be taken if activities during a shutdown cannot be completed within the allotted times.
 - 6. Name and contact information of individual in charge of activity during shutdown.

1.3 PROJECT SPECIFIC WORK CONSTRAINTS

- A. Access to the existing pump house, generator, and meter vaults must be maintained until new well pump and booster system are in operation. The existing wells, booster system, piping, and flow meters must remain in operation until new facilities are accepted by the City and are in operation. One clearwell must remain in operation at all times.
- B. Treatment systems, including all ancillary equipment (chemical injection systems, distribution pumps, etc.) shall be constructed, tested for component operation, and disinfected prior to modifying any well pumping system.
- C. Unless otherwise obtained by the Contractor, staging for the project shall be limited to the project site.

1.4 GENERAL WORK CONSTRAINTS

- A. Constraints primarily relate to interfacing with and tying into existing pipelines, power supply, equipment, and other aspects of the operating water system.
- B. Make every effort to give proper attention to each of these items so as to minimize interruptions of the existing facilities and avoid delays that may result if the constraints are not observed.
 - 1. Coordinate construction schedule and operation with Owner.
 - 2. Coordinate proposed work with Owner, Engineer, and facility operations personnel before implementing unit shutdowns. Under no circumstances cease Work at the end of a normal working day if such actions may inadvertently cause a cessation of any facility operating process; in which case, remain on site until necessary Work and/or repairs are complete.
 - 3. Owner recognizes portions of the facility and facility operations will have to be interrupted or shut down or interfered with in order to accommodate construction activities. Owner will, through its personnel, attempt to accommodate Work, provided that proper notification is given. Owner reserves the right to deny permission for interruption or shutdown on any day.
 - 4. Do not operate any of the existing equipment without written permission from Owner naming the specific piece of equipment, operator(s), and dates equipment may be used. Contractor is liable for any loss or damage caused to property or equipment or any personal injury resulting from or related to this usage.
- C. Extended Working Hours: If it is desired to perform any Work outside the specified working hours, obtain written permission from Owner and all necessary permitting agencies, and make all necessary arrangements prior to commencing.

1.5 TEMPORARY SHUTDOWNS

- A. Provide 14-day minimum advance notice to request approval of a temporary shutdown of a facility.
- B. Each Notice of Request for Approval of a Temporary Shutdown submitted to Owner shall include the following:
 - 1. Dates, times, and duration of proposed shutdown.
 - 2. Work activities to be performed during the shutdown.
 - 3. Assistance required of Owner's personnel before, during, and after shutdown.
 - 4. Personnel to be on Site during shutdown.
 - 5. Contingency plan if work during shutdown is not completed during allotted time or critical equipment fails.
- C. Upon receipt of such request, Owner will decide what action(s) is required by Owner and if the requested shutdown is acceptable considering the system demand at that time. The request from Contractor will be returned to Contractor with the Owner's written decision noted. If Owner deems that the requested shutdown is unacceptable, Owner will state such reasons, and Contractor shall reschedule the shutdown as required.
- D. It is hereby agreed between the Contractor and Owner that disapproval by Owner of the Contractor's shutdown request does not entitle Contractor to any time extension unless Contractor can demonstrate to the satisfaction of Owner, through an updated CPM schedule, that the overall project completion date will not be met as a result of this disapproval.
- E. Owner may postpone a planned and approved shutdown at any time for pumping capacity, or safety reasons.

1.6 INTERRUPTION OF UTILITY SERVICE

- A. Indicate required shutdowns of existing utilities or interruptions of existing operations on Progress Schedule. Interruptions to utility service will be allowed to the extent that customer service will not be adversely compromised.
- B. Submit requests for interruptions to utility service not less than five business days in advance of the date scheduled for the interruption.
- C. Following receipt of the request, Engineer will notify Contractor if the requested date will be permitted. Evaluation of the request will be based upon the availability of the

utility owner's personnel to assist and monitor utilities during the shutdown period and impact to customer service.

- D. Minimize the period of interruption by thorough advance planning. Procure and provide all required materials, equipment, and labor on site during the shutdown.
- E. Do not begin interruption until written authorization is received from Engineer.

1.7 POTENTIAL CONSTRUCTION SEQUENCE OF KEY ITEMS

- A. Potential construction sequence listed below is associated with key items only. Contractor shall comply with all requirements of these Contract Documents in developing a detailed sequence of construction
 1. Establish temporary site security, ESC measures, and utilities.
 2. Relocate existing water and drain pipes in conflict with new building foundation.
 3. Construct new sewer line, including all manholes and paving in St. Andrews Drive SW.
 4. Construct new site piping, short of connections to existing piping.
 5. Construct booster pump and treatment building.
 6. Construct new electrical service and all other electrical/control conduits.
 7. Install new Well 11 pump, electrical equipment, and chemical treatment equipment within the building.
 8. Connect new Well 11 pump and booster system to existing system. Existing wells and pump building to remain in service.
 9. Disinfect, test, and obtain City acceptance of Well 11 pump, piping, booster pump, and treatment system equipment. After obtaining acceptance, begin regular operation of the new facility.
 10. Remove Wells 1, 2, and 3 from service. Abandon all existing and temporary water piping and electrical connections from Wells 1 and 2. Cap and decommission Wells 1 and 2. Cut and install vault with spool piece for potential future connection of Well 3.
 11. Take Clearwell A out of operation. Clean, blast, coat, and disinfect tank prior to placing back in operation. Replace tank equipment. Return Clearwell A to service.
 12. Take Clearwell B out of operation. Clean, blast, coat, and disinfect tank prior to placing back in operation. Replace tank equipment. Return Clearwell B to service.

13. Complete site grading, surface restoration, site cleanup, and any final punchlist items.

14. Obtain City acceptance of complete project. Close out project.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

**SECTION 01 22 20
UNIT PRICE MEASUREMENT AND PAYMENT**

PART 1 GENERAL

Measurement and payment will be on a unit price basis in accordance with the prices set forth in the proposal for individual work items. Where work is required but does not appear as a separate item in the proposal, the cost for that work shall be included and absorbed in the unit prices named in the proposal. Contractor shall make a careful assessment when preparing the bid.

For lump sum bid items, CONTRACTOR shall provide a schedule of values for all the Work which will include quantities and prices of items aggregating the lump sum bid price and will subdivide the Work into component parts in sufficient detail to serve as the basis for progress payments during construction. Such process will include an appropriate amount of overhead and profit applicable to each item of Work. The Schedule of Values will serve as the basis for progress payments and will be incorporated into a form of Application of Payment acceptable to the ENGINEER.

1. Mobilization, Bonds, Insurance, and Demobilization: Payment for mobilization, bonds, insurance, and demobilization will be on a lump sum basis. The amounts paid for mobilization in the contract progress payment will be based on the percent of the original contract amount that is earned from other contract items, as follows:
 - A. When 5 percent of original contract is earned, up to 75 percent of the amount for mobilization or 5 percent of the original contract amount, whichever is the least.
 - B. Commissioning: 10 percent of the amount for mobilization
 - C. Record Drawings: 5 percent of the amount for mobilization
 - D. O&M Manuals: 5 percent of the amount for mobilization
 - E. When all work is completed, remainder of mobilization exceeding 5 percent of the original contract amount.

This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the contract.

2. Traffic Control: Payment for traffic control will be on a lump sum basis. Payment shall include, but not be limited to, obtaining approved permits from applicable entities, furnishing, placing, maintaining, replacing, relocating, adjusting, aligning, and removing flagger service, pilot vehicles, warning lights, electronic arrows, channelizing devices, traffic barrier service, traffic barrier service guardrail terminals, impact attenuator service, construction pavement markings, construction pavement message markings, temporary pavement markers, eradication of existing pavement markings, temporary detours,

aggregate material, Type III barricades, construction signs, truck mounted attenuators, and all labor, material and equipment incidental to completing this work. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.

3. Surveying and Construction Staking: Payment for surveying and construction staking will be on a lump sum basis. Payment shall include full compensation for construction surveying and staking at and around the water system property. Payment includes all preparatory and field work required to locate and provide horizontal and vertical control prior to construction. No additional compensation will be provided for replacement of damaged or lost field control, regardless of reason for loss. This lump sum bid item includes all costs for utility coordination as noted in the drawings and specifications. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
4. Erosion and Sedimentation Control: Payment for planning, installing, maintaining, and removing approved temporary and permanent erosion and sedimentation control devices will be on a lump sum basis. Payment shall include, but not be limited to, silt fencing, tree protection or removal, and temporary construction entrance, as required, including all labor, materials, and equipment. Included in the lump sum price for this bid item are all costs for additional temporary erosion control measures which may be required to support the CONTRACTOR's construction methods, including but not limited to street cleaning, including sweeping and washing, straw mulch, protection of delivered or stockpiled backfill materials, protection of unsuitable or surplus material and control, care and cleanup of petroleum products or other construction byproducts. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
5. Sheeting, Shoring, and Bracing: Payment for sheeting, shoring, and bracing will be on a per lump sum basis. Payment shall include all work and materials necessary for a complete installation in compliance with the Contract Documents and applicable regulations and laws. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
6. DI Pipe for Water Main, 8 In. Diam.: Payment for 8-inch ductile iron pipe for water mains will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, all required joint restraint systems for pipe, fittings, valves, and appurtenances, standard concrete thrust blocks (including concrete, excavation, and thrust plates), dewatering, pipe bedding, pipe zone, trench backfill and temporary asphaltic concrete surfacing as required, buried valves including valve boxes, covers, risers, and extensions if required, and fitting accessories including glands, bolts, and gaskets. Payment shall include total length of piping constructed with restrained joints as indicated on the plans, fittings, and valves. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as

shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required to cutting existing piping, installation of branch-line fittings, and/or connection to existing pipelines.

7. DI Pipe for Water Main, 10 In. Diam.: Payment for 10-inch ductile iron pipe for water mains will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, all required joint restraint systems for pipe, fittings, valves, and appurtenances, standard concrete thrust blocks (including concrete, excavation, and thrust plates), dewatering, pipe bedding, pipe zone, trench backfill and temporary asphaltic concrete surfacing as required, buried valves including valve boxes, covers, risers, and extensions if required, and fitting accessories including glands, bolts, and gaskets. Payment shall include total length of piping constructed with restrained joints as indicated on the plans, fittings, and valves. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required to cutting existing piping, installation of branch-line fittings, and/or connection to existing pipelines.
8. DI Pipe for Water Main, 12 In. Diam.: Payment for 12-inch ductile iron pipe for water mains will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, all required joint restraint systems for pipe, fittings, valves, and appurtenances, standard concrete thrust blocks (including concrete, excavation, and thrust plates), dewatering, pipe bedding, pipe zone, trench backfill and temporary asphaltic concrete surfacing as required, buried valves including valve boxes, covers, risers, and extensions if required, and fitting accessories including glands, bolts, and gaskets. Payment shall include total length of piping constructed with restrained joints as indicated on the plans, fittings, and valves. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required to cutting existing piping, installation of branch-line fittings, and/or connection to existing pipelines.
9. PVC Pipe for Drain, 4 In. Diam.: Payment for 4-inch drain will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, dewatering, pipe bedding, pipe zone, trench backfill and temporary asphaltic concrete surfacing as required, and testing. Payment shall include total length of piping constructed. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required for a complete drain installation.
10. PVC Pipe for Drain, 10 In. Diam.: Payment for 10-inch drain will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, dewatering, pipe bedding, pipe zone, trench

backfill and temporary asphaltic concrete surfacing as required, and testing. Payment shall include total length of piping constructed. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required for a complete drain installation.

11. DI Pipe for Storm, 8 In. Diam.: Payment for 8-inch drain will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, dewatering, pipe bedding, pipe zone, trench backfill and temporary asphaltic concrete surfacing as required, and testing. Payment shall include total length of piping constructed. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required for a complete pipe installation.
12. DI Pipe for Drain, 12 In. Diam.: Payment for 12-inch drain will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, dewatering, pipe bedding, pipe zone, trench backfill and temporary asphaltic concrete surfacing as required, and testing. Payment shall include total length of piping constructed. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required for a complete pipe installation.
13. PVC Pipe for Gravity Sewer, 8 In. Diam.: Payment for 8-inch gravity sewer will be on a per lineal foot basis. Payment shall include all work and materials, excavation to depths shown in the Drawings, disposal of excavated material as required, dewatering, pipe bedding, pipe zone, trench backfill and temporary asphaltic concrete surfacing as required, and sewer testing. Payment shall include total length of piping constructed. Pipe bedding, pipe zone, and trench backfill material shall be as specified in Division 31 and as shown in the Drawings. The lineal foot price shall include any incidental excavation, backfill, potholing at all connections and utility crossings, and additional work required to cutting existing piping, installation of branch-line fittings, and/or connection to pipelines and manholes.
14. Piping, Fittings, Valves, and Appurtenances inside Pump Station Building: Payment for all piping, fittings, valves, and appurtenances within the Booster Pump and Treatment Building, including within Well No. 11, as shown and described in the Contract Documents will be on a lump sum basis. Payment shall include all costs for work and materials, pipe supports, dismantling joints, flow meters, pressure gauges, sampling taps, chemical injection piping and accessories, and other items not included in other bid items. Payment shall include total length of piping constructed, fittings, and valves. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.

15. 48-inch Concrete Manholes: Payment for 48-inch concrete manholes will be on a per each basis. Payment shall include full compensation for all labor, materials, and equipment for construction of the manhole structure, including manhole risers, cones, frames, lids, and grade rings as necessary, excavation to depths shown in the Drawings, disposal of excavated material as required, dewatering, backfill, and testing.
16. 60-inch Concrete Dechlorination Manhole: Payment for a 60-inch concrete dechlorination manhole will be on a per each basis. Payment shall include full compensation for all labor, materials, and equipment for construction of the manhole structure, including dichlorination basket and supports, manhole risers, cones, frames, lids, and grade rings as necessary, excavation to depths shown in the Drawings, disposal of excavated material as required, dewatering, backfill, and testing.
17. Booster Pump and Treatment Building: Payment for the Booster Pump and Treatment Building will be on a lump sum basis. Payment shall include all costs for constructing the building as shown and described in the Contract Documents. Payment shall include full compensation for all material, manufacturing, transporting, delivering, handling, installation, labor and equipment for construction of the new Booster Pump and Treatment structure, including HVAC equipment, plumbing fixtures, excavation and compaction, disposal of excavated material as required, and any other items not included in other bid items necessary to provide a fully functioning Booster Pump and Treatment Building, complete, in place, tested, and ready for use. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
18. Well No. 11 Pump: Payment for the Well No. 11 pump will be on a lump sum basis. Payment shall include full compensation for all material, manufacturing, transporting, delivering, handling, installation, labor, equipment, disinfection and testing necessary to provide a fully functioning well pump. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
19. Booster Pumps: Payment for furnishing and installing the booster pumps will be on a per each basis. Payment shall include full compensation for all material, manufacturing, transporting, delivering, handling, installation, labor, equipment, and testing necessary to provide a fully functioning booster pump station.
20. Chlorination System: Payment for the chlorination system will be on a lump sum basis. Payment shall include full compensation for all material, piping, fittings, valves, and mechanical equipment as specified in the Contract Documents, manufacturing, transporting, delivering, handling, installation, labor, plumbing, and testing necessary to provide a fully functioning chlorination generation and injection system, including chlorine generator, metering pumps, tanks, and injection quill. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.

21. Fluoridation System: Payment for the fluoridation system will be on a lump sum basis. Payment shall include full compensation for all material, piping, fittings, valves, and mechanical equipment as specified in the Contract Documents, manufacturing, transporting, delivering, handling, installation, labor, plumbing, and testing necessary to provide a fully functioning fluoridation system, including saturator, metering pumps, and injection quill. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
22. Water Sampling Station: Payment for the Water Sampling Station will be on a lump sum basis. Payment shall include full compensation for all material, piping, fittings, valves, and analyzers as specified in the Contract Documents, manufacturing, transporting, delivering, handling, installation, labor, plumbing, and testing necessary to provide a fully functional water sampling station. Payments will be based on the percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the owner.
23. Electrical and Instrumentation: Payment for all electrical and instrumentation work will be on a lump sum basis. Payment shall include all costs for material, manufacturing, transportation, delivering, handling, installation, testing, labor, and equipment required for construction of all electrical and instrumentation components and systems associated with Well No. 11 and the Booster Pump and Treatment Building. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
24. Generator Set: Payment for the generator set will be on a lump sum basis. Payment shall include full compensation for all material, manufacturing, transporting, delivering, handling, installation, labor, equipment, and testing necessary to provide a fully functioning generator set. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
25. Testing, Flushing, and Disinfection of Water Mains: Payment for testing, flushing and disinfection of water mains will be on a lump sum basis. Payment shall include furnishing, installing, and removing temporary blowoff piping including miscellaneous piping, valves, fittings, and thrust restraint. The Owner shall provide off-site laboratory analysis. Payment for any retesting shall be paid by the Contractor. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
26. Well Decommissioning, Abandoning Existing Pipe, and Site Demolition: Payment for well decommissioning, abandoning existing pipe, and site demolition will be on a lump sum basis. Payment shall include full compensation for all materials, work, labor, equipment, transportation and handling for removal of all structures, equipment, piping, valves and valve vaults, meters and meter vaults, and appurtenances onsite, and salvage, as defined

in the Contract Drawings and Specifications, disconnection of existing mains, capping of abandoned pipe ends, excavation, pipe hole cutting, backfill, and restoring excavations. Demolition of existing equipment must be in accordance with Section 01 12 16, Work Sequence. Payment shall include the handling, removal, and disposal of hazardous building materials within the existing structure in accordance with all local, state and federal regulations and guidelines. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.

27. Clearwell Rehabilitation: Payment for clearwell rehabilitation will be on a lump sum basis. Payment shall include full compensation for all labor, materials, and equipment for the rehabilitation of the two existing water tanks including new access hatches, exterior mechanical floats, vents, transducers, cleaning and surface preparation, exterior architectural coating, interior coating, leakage testing, and disinfection. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
28. Hot Mix Asphalt: Payment for hot mix asphalt will be made on a per ton basis. Payment shall include full compensation for all labor, materials, and equipment necessary for installing and compacting the HMA as shown on the Drawings.
29. Crushed Surfacing Top Course: Payment for crushed surfacing top course will be made on a per ton basis. Payment shall include full compensation for all labor, materials, and equipment necessary for installing and compacting the CSBC for surface restoration and paving sections as shown on the Drawings. Trench backfill material is incidental to pipe installation and is not included in this bid item.
30. Crushed Surfacing Base Course: Payment for crushed surfacing base course will be made on a per ton basis. Payment shall include full compensation for all labor, materials, and equipment necessary for installing and compacting the CSBC for surface restoration and paving sections as shown on the Drawings. Trench backfill material is incidental to pipe installation and is not included in this bid item.
31. Final Site Grading, Surface Restoration, Access Road Maintenance, and Site Clean-Up: Payment for final site grading, surface restoration, and site clean-up will be on a lump sum basis. Payment shall include stripping and stockpiling topsoil, regrading to original contours, bark mulching planting areas, application of seeding, maintaining and resurfacing gravel surfaces, landscaping, installation of bollards, cleanup following construction, and all other site improvements to make the project complete. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.
32. Bioswale: Payment for bioswale will be on a lump sum basis. Payment shall include construction of a bioswale as shown in the Contract Documents, including all labor, equipment, and materials to excavate and dispose of native soils, grading, furnishing and

installation of drain rock, geotextile, bioretention soil, compost mulch, plantings, and plant maintenance. Progress Payments will be based on percentage of the work completed, according to the Schedule of Values submitted by the Contractor as approved by the Owner.

33. Minor Changes: Payment for minor changes will be on a force account basis. No payment shall be made without prior authorization from Engineer. A fixed amount of \$100,000 shall be included for uniform bidding purposes.

END OF SECTION

**SECTION 01 33 00
SUBMITTAL PROCEDURES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section contains administrative and procedural requirements for submittals for review, information, and for Project closeout.

- B. Section includes:
 - 1. Schedule of Submittals.
 - 2. Submittal requirements.
 - 3. Submittal procedures.
 - 4. Engineer review.
 - 5. Resubmittal procedures.
 - 6. Product data.
 - 7. Shop Drawings.
 - 8. Samples.
 - 9. Design data.
 - 10. Test reports.
 - 11. Certificates.
 - 12. Manufacturer's instructions.
 - 13. Manufacturer's field reports.
 - 14. Erection Drawings.
 - 15. Construction progress schedules.
 - 16. Breakdown of contract price.
 - 17. Construction photographs.
 - 18. Operation and maintenance (O&M) instructions.

1.2 DEFINITIONS

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

1.3 SCHEDULE OF SUBMITTALS

- A. Within 10 days after the Effective Date of the Contract, Contractor shall submit to Engineer a preliminary Schedule of Submittals, including proposed list of major products proposed for use, with specification section reference, name of Manufacturer, supplier, trade name, subcontractor, and model number of each product. Provide a schedule of specific target dates for the submission and return of submittals and shop drawings required by the Contract Documents.
- B. For products specified only by reference standards, indicate Manufacturer, trade name, model or catalog designation, and reference standards.
- C. The list and schedule shall be updated and resubmitted when requested by the Engineer.
- D. Contractor's Schedule of Submittals will be acceptable to the Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

1.4 SHOP DRAWING AND SAMPLE SUBMITTAL REQUIREMENTS

- A. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - 1. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - 2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - 3. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

- B. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
- C. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review of each such variation.

1.5 SUBMITTAL PROCEDURES

- A. Contractor shall submit Shop Drawings and Samples to Engineer for review in accordance with the accepted Schedule of Submittals.
- B. Transmit each submittal with Engineer-accepted transmittal form certifying compliance with requirements of Contract Documents.
- C. Sequentially number transmittal forms. Mark transmittal forms for resubmittals with original number and sequential alphabetic suffix.
- D. Show each Submittal with the following numbering and tracking system:
 - 1. Submittals shall be numbered according to specification section. For example, the first product submittal for Section 05 50 00 would be "05 50 00-1". Resubmittals of that submittal would be "05 50 00-1.1", followed by "05 50 00-1.2", and so on. The second product submittal for that Section would be "05 50 00-2".
 - 2. Submittals containing product information from multiple sections of the specifications will not be reviewed. Contractor and/or their supplier shall divide submittals in a manner that meets the numbering and tracking system requirements stated herein.
 - 3. Alternative method of numbering may be used if acceptable to Engineer.
- E. Identify: Project, Contractor, subcontractor and supplier, pertinent drawing and detail number, and specification Section number appropriate to submittal.
- F. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- G. Coordinate submission of related items.

1. All shop drawings for interrelated items shall be scheduled for submission at the same time.
 2. The Engineer may hold shop drawings in cases where partial submission cannot be reviewed until the complete submission has been received or where shop drawings cannot be reviewed until correlated items affected by them have been received. When such shop drawings are held, the Engineer will advise the Contractor in writing that the shop drawing submitted will not be reviewed until shop drawings for all related items have been received.
- H. When hard copies of submittals are provided by the Contractor, six copies of all materials shall be provided to the Engineer. Two copies of reviewed submittals will be kept by the Engineer, two copies of reviewed submittals will be transmitted to the Owner, and two copies of reviewed submittals will be returned to the Contractor. If the Contractor requests that more than two copies of the reviewed submittal be returned, then the Contractor shall submit the appropriate quantity of submittals.
- I. When electronic transmittals of submittals are provided by the Contractor under established protocols described elsewhere in the Contract Documents or as jointly developed by the Owner, Engineer and Contractor, provide electronic submittals in portable document format (PDF) in addition to the source document format (Word, Excel, AutoCAD, etc.). Reviewed submittals will be returned to the Contractor as PDF electronic files.
- J. For each submittal for review, allow not less than 14 days for Engineer review, excluding delivery time to and from Contractor.
- K. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- L. Allow space on submittals for Contractor and Engineer review stamps or comments.
- M. When revised for resubmission, the Contractor shall identify changes made since previous submission. A narrative of changes shall be provided, and shop drawings or calculations shall indicate that a revision was made.
- N. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with review comments.
- O. Submittals not requested will not be recognized nor processed.
- P. Incomplete Submittals: Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Engineer.

1.6 ENGINEER REVIEW

- A. Informational submittals and other similar data are for Engineer's information, do not require Engineer's responsive action, and will not be reviewed or returned with comment.
- B. The Engineer's review of submittals and shop drawings is not a check of any dimension or quantity and will not relieve the Contractor from responsibility for errors of any sort in the submittals and shop drawings.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. The Engineer will review the submitted data and shop drawings and return to the Contractor with notations thereon indicating "No Exception Taken", "Make Corrections Noted", "Rejected", "Revise and Resubmit", or "Submit Specified Item".
- E. If more than two submissions of an item are required to meet the Project specifications, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.
- F. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
- G. Engineer's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
- H. Engineer's review of a separate item as such will not indicate approval of the assembly in which the item functions.
- I. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 1.4.C and Engineer has given written acceptance of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such accepted variation from the requirements of the Contract Documents in a Field Order.
- J. Engineer's review of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 1.4 A. and B.

- K. Engineer's review of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
- L. Neither Engineer's receipt, review, return of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.
- M. Contractor shall perform the Work in compliance with the requirements and commitments set forth in returned Shop Drawings and Samples, subject to the provisions of Paragraph 1.6.I.

1.7 RESUBMITTAL PROCEDURES

- A. Contractor shall make corrections required by Engineer and shall return the required number of corrected copies of Shop Drawings and submit, as required, new Samples for review. Contractor shall direct specific attention in writing to revisions other than the corrections called for by Engineer on previous submittals.
- B. Contractor shall furnish required submittals with sufficient information and accuracy to obtain required review of an item with no more than two submittals. Engineer will record Engineer's time for reviewing a third or subsequent submittal of a Shop Drawings, sample, or other item requiring review, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
- C. If Contractor requests a change of a previously reviewed submittal item, Contractor shall be responsible for Engineer's charges to Owner for its review time, and Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges, unless the need for such change is beyond the control of Contractor.

PART 2 PRODUCTS

2.1 CONSTRUCTION PROGRESS SCHEDULES

- A. Within 10 days after the Effective Date of the Contract, prepare and submit to the Engineer a practicable schedule showing the order in which the Contractor proposes to carry out the Work, the dates on which the important features of the work will start, and the contemplated dates for completing same. In addition to a time-scaled bar chart schedule depicting the Project critical path, the Contractor shall submit a detailed CPM logic diagram. The CPM diagram and time-scaled bar chart shall include the following:

- Construction activities
- Submittal and review of material samples and shop drawings
- Procurement and delivery of critical materials
- Fabrication, installation, and testing of special material and equipment
- Duration of work, including completion times of all stages and their sub-phases

The activities shall be separately identifiable by coding or use of sub-networks or both. The duration of each activity shall be verifiable by manpower and equipment allocation, in common units of measure, or by delivery dates and shall be justifiable by the Contractor upon the request of the Engineer.

Detailed subnetworks will include all necessary activities and logic connectors to describe the work and all restrictions to it. In the restraints, include those activities from the Project schedule which initiated the subnetwork as well as those restrained by it.

Include a tabulation of each activity in the computer mathematical analysis of the network diagram. Furnish the following information as a minimum for each activity:

- Event (node) number(s) for each activity
- Activity description
- Original duration of activities (in normal workdays)
- Estimated remaining duration of activities (in normal workdays)
- Earliest start date or actual start date (by calendar date)
- Earliest finish date or actual finish date (by calendar date)
- Latest start date (by calendar date)
- Latest finish date (by calendar date)
- Slack or float time (in workdays)

Computer printouts shall consist of at least a node sort and an “early start/total-float” sort.

- B. Attention is drawn to typical local climatic weather patterns and Work shall be coordinated accordingly.
- C. Complete Project schedule shall be revised and resubmitted to the Engineer at a minimum occurrence of every four weeks for review.
- D. Three Week Lookahead Schedules: Provide each week at the weekly construction meeting. The previous week’s completed work shall be shown on the schedule for a total of 4 weeks shown.

2.2 BREAKDOWN OF CONTRACT PRICE

- A. Within 10 days after the Effective Date of the Contract, submit a complete breakdown of all lump sum bid items showing the value assigned to each part of

the work, including an allowance for profit and overhead adding up to the total lump sum contract price.

- B. Breakdown of lump sum bids shall be coordinated with the items in the schedule and shall be in sufficient detail to serve as the basis for progress payments during construction.
- C. Engineer will review the contract price breakdown and may request items to be further broken down or for more items be added in order to facilitate tracking of work progress for payment.
- D. Preparatory work, bonds, and insurance required in setting up the job will be allowed as a separate entry on the cost breakdown but shall not exceed 5 percent of the total base bid.
- E. Upon acceptance of the breakdown of the contract price by the Engineer, it shall be used as the basis for all requests for payment.

2.3 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents. Submitted data shall be sufficient in detail for determination of compliance with the Contract Documents.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement Manufacturers' standard data to provide information specific to this Project.
 - 1. Note submittal will be returned to Contractor without review of submittal if products, models, options, and other data are not clearly marked or identified.
- C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.4 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.

- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer licensed in the state of Project, responsible for designing components shown on Shop Drawings.
 - 1. Include signed and sealed calculations to support design.
 - 2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
 - 3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. All dimensioned shop drawings shall be scalable and provided as full-sized (22-inch x 34-inch) sheets. PDF electronic files shall print as scalable full-sized sheets.
- E. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.5 SAMPLES

- A. Samples: Action Submittal: Submit to Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
 - 1. Submit to Engineer for aesthetic, color, and finish selection.
 - 2. Submit Samples of finishes, textures, and patterns for Owner selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Engineer will retain one Sample.
- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. After review, produce copies and distribute according to Paragraph 1.5.M and for record documents.

2.6 DESIGN DATA

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

2.7 TEST REPORTS

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

2.8 CERTIFICATES

- A. Informational Submittal: Submit certification by Manufacturer, installation/application Subcontractor, or Contractor to Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Engineer.

2.9 MANUFACTURER'S INSTRUCTIONS

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

2.10 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Engineer's knowledge and records as Contract administrator or for Owner.
- B. Submit report within 48 hours of observation to Engineer for information.

- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

2.11 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Engineer's knowledge and records as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Engineer or Owner.

2.12 CONSTRUCTION PHOTOGRAPHS

- A. Provide photographs of Site and construction throughout progress of Work produced by an experienced photographer acceptable to Engineer.
- B. Each month submit photographs with Application for Payment.
- C. Photographs: Electronic, PDF, or JPEG format.
- D. Take minimum two Site photographs from different directions and 4 interior photographs of facilities indicating relative progress of the Work, 4 days maximum before submitting.
- E. Identify each photo in the electronic file name. Identify name of Project, phase, orientation of view, date, and time of view.
- F. Digital Images: Deliver complete set of digital image electronic files on CD-ROM to Owner with Project record documents. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as sensor, uncropped.
 - 1. Digital Images: Uncompressed TIFF or JPEG format, produced by digital camera with minimum sensor size of 4.0 megapixels, and image resolution of not less than 1600 by 1200 pixels.
 - 2. Date and Time: Include date and time in filename for each image.

2.13 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

- A. Submit preliminary O&M materials for review by Engineer. The Equipment Manufacturer may furnish instruction manuals prepared specifically for the equipment furnished or standard manuals may be used if statements like "if your

equipment has this accessory..." or listings of equipment not furnished are eliminated. O&M materials will be returned to the Contractor for resubmittal if the O&M materials do not clearly indicate what specific equipment was furnished and all items not provided being clearly crossed out. Poorly reproduced copies are not acceptable. Operation and maintenance instructions shall contain the following as a minimum:

1. Reviewed shop drawings and submittal data;
 2. Model, type, size, and serial numbers of equipment furnished;
 3. Equipment and driver nameplate data;
 4. List of parts showing replacement numbers;
 5. Recommended list of spare parts;
 6. Complete operating instructions including start-up, shutdown, adjustments, cleaning, etc.;
 7. Maintenance and repair requirements including frequency and detailed instructions; and
 8. Name, address and phone numbers of local representative and authorized repair service.
- B. Following review of the preliminary O&M materials by the Engineer and before acceptance of the Work, submit four copies of complete final operation and maintenance instructions for all equipment supplied. Submit items in 8-1/2 x 11-inch heavy-duty three-ring binders when appropriate, or in 8-1/2 x 11-inch file folders. All binders and folders shall have clear plastic pockets on the front of the cover and the spine to allow for insertion of identifying information.

2.14 OTHER REQUIRED SUBMITTALS

- A. Other required submittals include the items listed below. This list is provided for Contractor's convenience only and may not be complete in all respects. Contractor shall provide all submittals specified or required, whether or not listed here.
1. Contractor Emergency Contact List.
 2. Erosion and Sediment Control Plan.
 3. Traffic Control and Protection Plan.

4. Work Sequencing Plan.
5. Temporary Shutdown Plan.

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 41 20
SEISMIC REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS

PART 1 GENERAL

1.1 SUMMARY

- A. This section contains seismic design requirements for non-structural equipment, components and systems. The components and systems indicated below are required for immediate re-occupancy and minimization of disruption to operations following a seismic event. All elements shall meet the requirements of this section and Chapter 13 of ASCE 7-16.

- B. Applicable Specification Divisions include those with:
 - 1. Components that are part of the Designate Seismic Systems as covered in the **2018 IBC** Section 1705.13.3 and subject to the requirements of ASCE 7 Section 13.2.2.
 - 2. Components weighing more than 400 pounds that have a center of mass located 4-feet or less above the adjacent floor or roof level that supports the component.
 - 3. Components weighing more than 20 pounds, or more than 5 lbs./ft. in the case of distributed systems, located more than 4-feet above the adjacent floor or roof level that supports the component.
 - 4. Exceptions:
 - a. Furniture
 - b. Temporary or movable equipment

1.2 ACCEPTED STANDARDS

- A. ASCE 7-16 Section 13.2.2 requires certification be provided for mechanical, electrical, and containment and storage equipment that is identified as being assigned to the Designate Seismic System. This designation requires said systems to remain operable and functional following the design earthquake ground motion. Documentation confirming suitability shall be provided as outlined in the Submittal Section.

- B. ASCE 7-16 Section 13.1.7 allows for the use of reference documents or standards for industry specific systems or components which represent acceptable procedures for seismic design and construction. The use of these documents or standards does not alleviate the Contractor from submitting calculations, drawings and product data that show conformance to the requirements of this section.

- C. Pre-approved details meeting the requirements of ASCE 7-16 Section 13.3 may be used for this project without submitting calculations indicating compliance with the design criteria specified in Section 1.6 Design Criteria. The Contractor shall provide shop drawings detailing the product and specifying the pre-approved detail(s) to be used and their locations along with supporting documentation.

1.3 SUBMITTALS

- A. Special Certifications for the Designated Seismic System:
 - 1. For active Mechanical and Electrical Equipment, submit one of the following forms of documentation for each main component of the system.
 - a. Approved Shake Table Test results per ASCE 7 Section 13.2.5
 - b. Experience Data per ASCE 7 Section 13.2.6
 - c. Inherent Ruggedness per ASCE 7 Section 13.2.5
 - 2. For non-active Mechanical and Electrical Equipment, submit one of the following forms of documentation for each main component of the system.
 - a. Analysis per ASCE 7 Section 13.2.2
 - b. Approved Shake Table Test results per ASCE 7 Section 13.2.5
 - c. Experience Data per ASCE 7 Section 13.2.6
 - 3. For component with hazardous substances, submit one of the following forms of documentation for each main component of the system.
 - a. Analysis per ASCE 7 Section 13.2.2
 - b. Approved Shake Table Test results per ASCE 7 Section 13.2.5
 - c. Experience Data per ASCE 7 Section 13.2.6
- B. Product data: Illustrate and indicate style, material, strength, fastening provision and finish for each type and size of seismic restraint component used.
- C. Shop drawings: Submit shop drawing plans and details indicating horizontal and vertical location (with respect to floor level and grids) layout, spacing, sizes and types of seismic restraint and gravity supports for each system or component requiring bracing. The connection details shall be on similar size plan sheets and clearly presented in the electronic submittal document. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices. Shop drawings shall be

stamped by a registered Structural Engineer in the State of Washington. The shop drawings must be clearly organized and presented such that they can be readily interpreted by the CONTRACTOR for installation and the Special Inspector. Include the following:

1. Fabricated Support: representations of field-fabricated supports not detailed on the Shop Drawings.
 2. Seismic Restraints: Detail anchorage and bracing not defined by other details or charts on the Shop Drawings. Include the following:
 3. Design: To support selection and arrangement of seismic restraints, include calculations of combined tensile, compressive and shear loads. NOTE: Anchorage to concrete shall comply with ACI 318-14, Chapter 17 assuming cracked concrete conditions.
 4. Details: Detail fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods and spacing. Identify components, list their strengths and indicate directions and values of forces transmitted to the structure during seismic events.
- D. Calculations: Calculations shall be submitted together with the Shop Drawings. Calculations shall substantiate the design of the sizes, thicknesses, and types of seismic-restraint connections, gravity support connections, fabrication, and attachment (fastening, anchorage, welding, etc.) to the structure, including all fasteners. Calculations shall clearly indicate the loads imposed on the primary building structure, including magnitude, direction and location. Calculations shall be based upon the design requirements in Section 1.6 Design Criteria shall be stamped by a registered Structural Engineer in the State of Washington.
- E. Welding certificates of welders performing component or system installation.
- F. Field Quality Control Reports
- G. Field Observation Reports from the Special Inspector

1.4 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in ASCE 7-16 unless requirements in this Section are more stringent.

1.5 DESIGN CRITERIA

- A. General. Seismic Demands on Non-Structural Components per ASCE 7-16 Section 13.3 are superseded by Sections 1.6.B and 1.6.C below. Conform to all other Sections of ASCE 7-16 Chapter 13.

B. Horizontal seismic forces. Design and detail all members and connections to meet the requirements of ASCE 7-16 based on the actual system or component operating weight. The design and evaluation of components and their support and attachments shall consider their flexibility as well as their strength. The following forces shall be used for all design and calculations.

1. Seismic Design Category: C
2. Risk Category: IV
3. F_p = horizontal seismic design force applied in any direction

$$F_p = 0.4 S_{DS} [(a_p W_p)(1+2z/h)] / (R_p / I_p)$$

$$F_{pMAX} = 1.6 I_p S_{DS} W_p$$

$$F_{pMIN} = 0.3 I_p S_{DS} W_p$$

4. a_p = component amplification factor, per ASCE 7-16 Chapter 13, unless specified elsewhere within individual Specification Divisions or individual Specification Sections
5. R_p = component response modification factor, per ASCE 7-16 unless specified elsewhere for individual Division or Specification Sections
6. W_p = component operating weight
7. I_p = 1.5, component importance factor.
8. z = height (in feet) above ground floor for the attachment of the component (see drawings for floor elevations). z shall be taken as zero below grade. The value of z/h need not exceed 1.0.
9. h = roof height above grade.
10. S_{DS} , Short Period Design Spectral Response Acceleration per the project Geotechnical Report shall be 1.304g

C. Vertical seismic forces. Calculate vertical seismic force by the following equation. The design force shall be applied vertically at the center of gravity of the component or distributed according to the mass distribution of the component or system. The vertical seismic force shall be combined with the horizontal seismic force as well as the Dead Load gravity force to determine the maximum force for component or anchorage design. Combine horizontal and vertical effects as indicated in ASCE 7-16, Section 13.3.1.

$$F_{pV} = +/-0.2 S_{DS}W_p$$

- D. Seismic attachments, bracing and anchorage shall be designed such that the component force is transferred to the lateral force resisting system of the structure through a complete load path. Attachments shall not be made across expansion and contraction joints.
- E. Components with vibration isolation systems shall have snubbers in each horizontal direction and vertical restraints as necessary to resist overturning.
- F. The seismic anchorage system shall provide restraint in all directions, including vertical, for each component or system for which seismic design is required.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

**SECTION 01 45 00
QUALITY CONTROL**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This Section covers quality control requirements supplementary to those of the General Conditions and Technical Specifications.

1.2 PROVISIONS

- A. Contractor's Responsibility for Testing

The Contractor shall be responsible for the cost of all testing as specified in this section. Additional information has been provided regarding the payment responsibility for the Owner with regards to the Project.

- B. Owner's Right to Perform Additional Tests

The Owner or Engineer reserves the right to complete additional testing. In such cases, the Contractor shall provide safe access for the Owner or Engineer and their inspectors to adequately inspect the quality of work and the conformance with Project specifications.

1.3 QUALITY ASSURANCE

- A. Testing Requirements

An independently owned and operated laboratory approved by the Engineer shall perform all testing as specified herein.

- B. Testing

1. General

- a. All required testing of work and/or materials shall be conducted in the presence of the Engineer. The Contractor shall provide 48-hour notification to the Owner and Owner's representative prior to conducting any and all quality assurance testing. Where applicable, work and materials shall only be buried with the consent of the Engineer.
- b. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample, or samples of material to be tested shall be selected by such laboratory or agency or by the Engineer. The Contractor shall furnish such samples of all materials without charge to Owner.

- c. The results from any and all tests are made for the information of the Owner. Regardless of any test results, the Contractor is solely responsible for the quality of workmanship and materials and for compliance with the requirements of the Drawings and Specifications.

2. Costs of Testing

- a. The Contractor shall be responsible for and shall pay for all tests as specified in Part 3 of this Section. Additional information has been provided regarding the payment responsibility for the Owner with regards to the Project.
- b. With regards to all materials to be tested, where test results demonstrate that the material or workmanship does not meet the minimum requirements of the Contract Documents, additional testing shall be completed and shall be paid for by the Contractor with no reimbursement by the Owner.

1.4 SPECIAL INSPECTIONS

Special inspections and testing as required by Chapter 17 of the IBC shall be conducted by Owner-retained Special Inspectors and Testing Agencies as required and as indicated in the Contract Documents.

A. Special Inspectors and Testing Agencies Responsibilities

- 1. Verify that manufacturers maintain detailed fabrication and quality control procedures and review the completeness and adequacy of those procedures to perform the Work.
- 2. Promptly notify Owner and Contractor of irregularities and deficiencies observed in the Work during performance of their services.
- 3. Submit certified written report of each test, inspection and similar quality control service to Owner, Contractor, and jurisdictional authorities. Interpret test results and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- 4. Submit final report of special inspections at Substantial Completion, including a list of unresolved deficiencies.
- 5. Re-test and re-inspect corrected work.

B. Contractor's Responsibilities

- 1. Provide quality requirements to all subcontractors and enforce all requirements.

2. Notify Owner, Engineer, Special Inspectors and Testing Agencies at least 48 hours in advance of time when Work that requires testing or special inspecting will be performed, unless otherwise indicated in the Contract Documents.
3. Pay for any Contractor requested testing and inspecting not required by the Contract Documents.
4. Pay for any re-testing or re-inspections by Special Inspectors and Testing Agencies for replacement work resulting from work that failed to comply with the Contract Documents. Owner will deduct such costs from the Contract Price.
5. Submit copies of licenses, certifications, correspondence, records, and similar documents used to establish compliance with standards and regulations that pertain to performance of the Work to the Owner, Engineer and Special Inspectors.
6. Where Special Inspection requires pre-construction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - a. Provide test specimens representative of proposed products and construction in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - b. Provide information on configurations of test assemblies, testing procedures and laboratory test records to adequately demonstrate capability of products to comply with performance requirements.
7. Cooperate with Agencies performing required tests, special inspections, and similar quality control services. Notify Agencies in advance of operations to permit assignment of personnel. Provide the following:
 - a. Access to the Work.
 - b. Incidental labor, equipment, and materials necessary to facilitate tests and special inspections.
 - c. Adequate quantities of representative samples of materials that require testing and inspecting. Assist Agencies in obtaining samples.
 - d. Provide facilities for storage and field curing of test samples.
 - e. Deliver samples to Testing Agencies.
8. Coordinate sequence of activities to accommodate required quality-assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and special inspecting.

9. Schedule times for tests, special inspections, obtaining samples, and similar activities. Distribute schedule to Owner, Engineer, Special Inspectors, Testing Agencies, and each party involved in portions of the work where tests and special inspections are required.

1.5 SUBMITTALS

A. Laboratory Test or Inspection Reports

Each report shall be signed and certified by the independently owned and operated testing laboratory. Unless otherwise specified, submit three copies of each report to the Owner or Owner's Representative.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 FIELD TESTING SCHEDULE

- A. The Contractor shall complete field testing in accordance with the following schedule. Additional source material testing shall be completed as necessary to establish the basis of field tests. The frequency of testing listed in this schedule lists the minimum number of tests per quantity of work completed by the Contractor. Testing locations to be determined by the Engineer.

Material to be Tested	Payment Responsibility	Minimum Testing Frequency
Structural Backfill	Owner	As required when placed. See detailed requirements in Section 31 23 23, Fill.
Trench Backfill	Contractor	As required when placed. See detailed requirements in Section 31 23 17, Trenching.
Asphalt Concrete	Contractor	As required when placed. See detailed requirements in Section 32 12 16, Asphalt Concrete Pavement.
Concrete	Owner	As required when placed. See detailed requirements in Section 03 00 00, Concrete General Requirements.
Grout	Owner	As required when placed. See detailed requirements in Section 03 00 00, Concrete General Requirements.
Masonry Mortar and Grout	Owner	As required when placed. See detailed requirements in Section 04 10 00.
Waterline – Hydrostatic testing and disinfection	Contractor	As required. See Section 33 13 00, Testing & Disinfection of Water Utility Piping.
Water Tank – Disinfection	Contractor	As required. See Section 33 13 13, Disinfection of Water Utility Storage Tanks.
Water Supply Wells – Disinfection	Contractor	As required. See Section 33 13 19, Disinfection of Water Supply Wells.
Sanitary Sewer – Testing	Contractor	As required. See Section 33 30 10.13, Sewer and Manhole Testing.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Temporary construction facilities and control requirements for the Work include the following. Contractor responsible for providing all other temporary facilities and controls necessary to complete the Work as described in the Contract Documents.
 - 1. Utilities including lighting and electricity, heat, telephone service, internet access and water.
 - 2. Sanitary facilities.
 - 3. Fire protection.
 - 4. Roads.
 - 5. Security fencing.
 - 6. Enclosures.
 - 7. Parking.
 - 8. Traffic Control.
 - 9. Owner's access to facilities.
 - 10. Field office for Contractor's personnel.
- B. Maintain temporary facilities in proper and safe condition throughout progress of Work.
- C. Comply with federal, state, and local codes and regulations, and utility company requirements.

1.2 LAYOUT OF TEMPORARY FACILITIES

- A. Before starting Work, submit to Owner, for approval, proposed layout of temporary facilities.
- B. Should Contractor require space in addition to that shown on Drawings, Contractor shall make arrangements for storage of materials and equipment in locations off Site.

1.3 UTILITY PROPERTIES AND SERVICE

- A. In areas where the Contractor’s operations are adjacent to or near a utility and such operations may cause damage which might result in significant expense, loss and inconvenience, the operations shall be suspended until all arrangements necessary for the protection thereof have been made by the Contractor.
- B. The Contractor shall notify all utility offices which may be affected by the construction operation at least 48 hours in advance. Before exposing any utility, the utility having jurisdiction shall grant permission and may oversee the operation. Should service of any utility be interrupted due to the Contractor’s operation, the proper authority shall be notified immediately. It is of the utmost importance that the Contractor cooperates with the said authority in restoring the service as promptly as possible. Any costs shall be borne by the Contractor.

Potable Water, Storm Drain	City of Port Orchard
Sanitary Sewer	City of Port Orchard
Natural Gas	Cascade Natural Gas
Power	Puget Sound Energy

- C. Contractor to contact one-number locator service (811) at least 48 hours in advance in advance of all excavations or other activities that may disturb and/or damage existing utilities. Existing utilities which may be impacted include the following.:

1.4 TEMPORARY LIGHTING AND ELECTRICITY

- A. General:
 - 1. Temporary lighting shall be sufficient to enable Contractor and Subcontractors to complete Work and enable Owner to observe Work. Illumination shall meet or exceed state code requirements.
- B. Temporary electric power may be obtained from Owner’s electrical system as follows:
 - 1. Power is available at the site but may be limited. Power is available within existing structures but maybe significantly limited due to existing equipment and loads.
 - 2. Make arrangements with Owner to review potential sources of temporary electricity and limitations of existing power supplies.
 - 3. Based on review and potential sources, Contractor shall develop a layout of temporary electrical power for review by Owner.

4. Contractor is responsible to implement temporary power and provide electrical protection to prevent disruption of plant power from over-current, ground faults, and short circuits.

C. Temporary Electric Power:

1. Provide, maintain, and remove temporary electric service facilities.
2. Provide temporary electric systems and components in conformance with requirements of National Electric Code and local authorities.
3. Facilities exposed to weather shall be weatherproof type.
4. Enclosures shall be locked to prevent unauthorized access.
5. Provide lamps, wiring, switches, sockets, and similar equipment required for temporary lighting and power tools.
6. Provide electric service to temporary offices.

1.5 TEMPORARY HEAT

A. General:

1. Provide heating required for cold weather protection for all facilities.
2. Provide heating required after enclosure of structure.
3. Except as otherwise called for, temperature shall be kept above 50°F.
4. Heat shall be warm air from oil, electric or gas-fired portable heaters suitably vented to outside.
5. Open salamander type heaters are not permitted.

B. Temporary Heating:

1. Provide temporary heat, pay fuel costs, and maintain heating units.
2. Provide adequate heat to all parts of structure.
3. Repair or replace materials damaged because of lack of heat.
4. Provide throwaway filters if permanent system used for temporary heat.
5. If permanent system is used for temporary heat during construction, all system components shall be cleaned at completion of work, including ductwork.

1.6 TEMPORARY COMMUNICATIONS

- A. Provide temporary telephone service for Contractor's use. Cell phones are acceptable.
- B. Provide temporary internet access service for Contractor's use. Internet access shall be capable of sending and receiving emails with large file attachments, drawings, spreadsheets, and other documents.

1.7 WATER FOR CONSTRUCTION AND TESTING

- A. Contractor is responsible for making all arrangements necessary for temporary water for construction.
 - 1. Water and temporary meter for construction purposes will be paid for by Contractor.
 - 2. The Contractor shall furnish all valves, hoses, connections, and other devices as necessary to obtain sufficient water for construction and for filling and testing of water lines as required. Fire hydrant use is allowed only by permission of the utility owner.
 - 3. Backflow protection is required on all connections to potable water systems.

1.8 SANITARY FACILITIES

- A. Provide temporary sanitary facilities conforming to state and local regulations, in sufficient numbers for use of Contractor's and Subcontractor's employees.
- B. Maintain in sanitary condition and properly supply with toilet paper.
- C. Use of the City's existing sanitary facilities is not allowed.

1.9 TEMPORARY FIRE PROTECTION

- A. Provide and maintain fire extinguishers and other fire protection equipment and devices as would be reasonably effective in extinguishing fires during early stages by personnel at Site.

1.10 TEMPORARY SITE AND OTHER ROADS

- A. Maintain existing roads used during construction free from accumulation of dirt, mud, and construction debris.
- B. Contractor shall repair or replace existing roads that remain to original or better condition prior to Final Completion. Survey and record condition of existing roads prior to construction.

1.11 CONTRACTOR'S WORK AREA

A. Work Area:

1. Limit construction operations and storage of equipment and materials to areas shown on Drawings and as determined by Owner.
2. Except as provided herein, no private property, or other area adjacent to Site shall be used for storage of Contractor's equipment and materials unless prior written approval is obtained from legal owner of the respective locations.
3. Contractor shall maintain staging areas during construction in a manner that will not obstruct operations of existing facilities. Work shall proceed in an orderly manner, maintaining construction Site and staging area free of debris and unnecessary equipment or materials.

B. Storage and Protection of Equipment and Materials:

1. The Contractor shall be solely responsible for the protection and security of all equipment and materials stored on the site. Equipment and materials stored at the site shall be placed neatly on the job site in an area and environment that will provide protection and security. Materials that are not adequately protected or stored in conformance with the Manufacturer's recommendations will be rejected. Unusable materials (i.e., rejected, or damaged liner material, old concrete chunks, metal scraps, etc.) shall be expeditiously removed from the job site.
2. Provide appropriate barricades, signs, and traffic control devices in like-new condition where necessary to protect the public and City employees from any hazards associated with the storage of materials and equipment used for this Project.
3. No equipment and/or materials shall be stored outside the immediate work area, in the following locations, or in the following manner:
 - a. In any maintained landscaped or lawn area.
 - b. In a manner that would totally eliminate an individual residents' street parking, or parking for the City's existing buildings.
 - c. In front of any business.
4. The "immediate work area" is the area where work is taking place or will be taking place within one calendar day. The Contractor shall immediately move stored material or equipment which causes a nuisance or creates complaints

1.12 SECURITY

- A. The McCormick Woods well field and pumping system site is fenced. No other security will be provided by Owner.
- B. Contractor shall be responsible for loss or injury to persons or property where Work is involved and shall provide security and take precautionary measures to protect Contractor's and Owner's interests.
- C. Provide and maintain temporary fencing of design and type needed to prevent entry into active construction areas.

1.13 ENCLOSURES

- A. Provide and maintain all enclosures, scaffolds, tarpaulins, canopies, warning signs, steps, platforms, bridges, and other temporary construction necessary for proper completion of Work.

1.14 PARKING

- A. Staging area and designated areas within construction limits may be used for parking of construction personnel's private vehicles and Contractor's lightweight vehicles. Parking shall not impede access or chemical deliveries to the existing facilities.
- B. Make arrangements for additional parking off site as required.
- C. No overnight parking, camping, or storage of personal vehicles, trailers or other items will be authorized.

1.15 TRAFFIC CONTROL AND PROTECTION

- A. The Contractor shall maintain traffic control and protection in the work areas 24 hours per day. Traffic control shall conform to the requirements set forth by the Washington State Department of Transportation as well as the standards set forth in the Manual on Uniform Traffic Control Devices (MUTCD) and local jurisdiction.
- B. The Contractor shall conduct its operations so as to keep one lane of traffic open for public and private access at all times on City, County and Public streets, roads and highways. Permits obtained for the Project may have more stringent requirements than noted in this section.
- C. Prior to beginning construction and as necessary or required by local or state agencies, the Contractor shall submit a detailed street closure and traffic control plan to the Owner for approval, which meets the requirements of the of the Washington State Department of Transportation. As construction proceeds, the Contractor shall notify the Owner as to the status of street closures and detours, if required.

- D. All work shall be carried on with due regard for safety to the public. Open trenches shall be backfilled or covered with steel plates at the end of each day.

1.16 CONTRACTOR'S FIELD OFFICES AND BUILDINGS

- A. If required by Contractor, erect where designated by Owner, and maintain temporary field office and tool and storage buildings for Contractor's use.
- B. As part of the temporary field office, Contractor shall provide a meeting room with adequate area, tables, and seating to conduct weekly progress meetings.
- C. Buildings or trailers shall be neat and well-constructed, surfaced with plywood, siding, hardboard, or other similar material, well painted and void of advertisements.

PART 2 PRODUCTS- (Not Used)

PART 3 EXECUTION

3.1 GENERAL

- A. Maintain and operate systems to ensure continuous service for duration of construction.
- B. Modify and extend systems, as Work progress requires.

3.2 REMOVAL

- A. Completely remove temporary materials, equipment, signs, and structures when no longer required.
- B. In unfinished areas, clean and repair damaged caused by temporary installations or use of temporary facilities, restore drainage, and evenly grade, seed, or plant as necessary to provide appearance equal to or better than original.
- C. In finished areas, restore existing or permanent facilities used for temporary services to specified, or original condition.

3.3 DAMAGE TO EXISTING PROPERTY

- A. Contractor is responsible for replacing or repairing damage to existing buildings, structures, sidewalks, roads, parking areas, and other existing assets.
- B. Contractor shall have option of having Owner contract for such Work and have cost deducted from Contract Price.

3.4 OWNER'S USE

- A. Upon acceptance of Work, or portion of work defined and certified as Substantially Complete by Owner, and Owner commences full-time successful operation of facility or portion thereof, Owner will pay cost for utilities used for Owner's operation. Contractor shall continue to pay for utilities used until final acceptance of Work, except as provided herein. However, heat for building as required for construction purposes shall still be paid by Contractor unless, due to occupancy by Owner, more heat shall be required due to increased temperature or lengthened duration, in which case Owner will bear difference in cost.

END OF SECTION

SECTION 01 56 39
TEMPORARY TREE AND PLANT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes provisions for temporary protection of trees and other plant life in preparation for site or building excavation Work.
- B. This specification shall be applied concurrently and in conjunction with other plant material protection measures herein described and specified.

PART 2 MATERIALS - Not Used

PART 3 EXECUTION

3.1 INSPECTION

- A. Inspect all trees specified on the Drawings for protection prior to construction.
 - 1. Document with written memorandum and photographs any unusual conditions.
 - 2. Submit copies of documentation to Engineer prior to beginning work.
- B. Verify all conditions on the Drawings with actual conditions at Site regarding tree protection prior to any site disturbance.
- C. The Engineer must be present during demolition of existing conditions occurring within the drip line of trees designated to remain.
- D. Notify Engineer 24 hours prior to inspections and/or tagging of protected trees.

3.2 PROTECTION

- A. Install barricades specified in the Drawings at drip lines of trees designated to remain prior to the commencement of construction.
- B. Clearly designate protected trees and clear of any material storage, personnel, or vehicular movement.
- C. Provide temporary fencing, barricades, and guards as necessary or required to protect trees designated on the Drawings to remain, from damage above and below grade.
- D. Protect root systems of trees and plant life to remain.

1. Protect from damage due to noxious materials in solution caused by runoff or spillage during mixing and placement of construction materials.
 2. Protect from flooding, erosion, or excessive wetting resulting from dewatering operations and compaction.
 3. Protect against unauthorized cutting, breaking, skinning roots and branches, or bruising bark.
 4. Protect from smothering and compaction.
 - a. Do not store construction materials or permit vehicles to drive or park within the drip line area of any tree to remain.
 5. Protect from dumping of refuse in close proximity.
- E. Where cutting is necessary, review conditions with the Engineer before proceeding, and comply with directives of Engineer.

3.3 EXCAVATION AROUND TREES

- A. Excavate within drip lines of trees only where indicated on the Drawings or as directed by Engineer.
- B. Where trenching for utilities is required within drip lines, tunnel under or around roots by hand excavating.
1. Where possible trench toward trunk of tree and tunnel under central root mass to avoid severing all lateral roots on side of trench.
 2. Do not cut main lateral roots or tap roots over 1-inch in diameter.
 3. Temporarily support and protect trees from damage until permanently covered with approved backfill.
- C. Do not allow exposed roots to dry out before backfill is placed.
1. Provide temporary earth or burlap cover.
 2. Water roots daily when exposed and maintain in a moist condition.
- D. Backfill roots only upon inspection approval from the Engineer.
1. Backfill around root excavations only with clean imported topsoil free from materials deleterious to root growth.

2. Backfill to eliminate voids and compact only by means of manual tamping at root areas.
 3. Water sufficiently to settle topsoil and eliminate voids or air pockets around roots.
 4. Allow for natural settlement of soil surface and furnish and apply topsoil sufficient to bring to original finish grade after backfill settlement.
- E. If during excavation, any condition arises that threatens the survivability of the protected tree, or an unknown condition arises that affects the stability or integrity of the root system, notify the Engineer immediately.

3.4 REPAIR AND REPLACEMENT OF DAMAGED TREES

- A. In the event of damage to existing trees:
1. Immediately prune limbs smaller than 3-inch caliper or roots smaller than 2-inch caliper to repair trees damaged by construction operations.
 2. Make repairs promptly after damage occurs to prevent progressive deterioration of damaged trees.
 3. Any such pruning and/or repairs shall be approved in advance and at completion by Engineer.
 4. The Engineer shall reserve the right, at cost to the Contractor, to obtain the services of a Certified Consulting Arborist with current membership in the American Society of Consulting Arborists to determine the severity of damage.
 5. The Contractor is responsible for the cost of repairs caused by their actions or by the actions of subcontractors engaged by the Contractor.
- B. Remove and replace dead or damaged trees which are determined by the Engineer to be incapable of restoration to normal growth patterns at no additional cost to Owner.
1. Provide new trees of the same species as those removed or damaged, with size and/or quantity to be determined by Engineer.
 2. Furnish replacement trees and plant life to the Site and plant, maintain, and warranty as directed by the Engineer.
 3. If trees are not replaceable with the same species, and size, compensate the Owner for the replacement cost of the trees based on the evaluation of a Certified Consulting Arborist.

4. The Contractor is responsible for additional costs of removing damaged trees and labor for planting new specimens.

3.5 DESIGNATED TREE REMOVAL PROCEDURES

- A. If designated tree removal is specified by Engineer, furnish labor, material, and equipment necessary for removing and/or salvaging existing trees, if necessary, as designated on the Drawings for removal.
 1. Verify location and species with Engineer prior to removal.
- B. Salable logs or timber may be sold to Contractor's benefit upon notification and prior approval of Owner. Upon approval, remove salable logs or timber promptly from site.

3.6 GRADING AND FILLING AROUND TREES

- A. Maintain existing grade within drip line of trees unless otherwise indicated on the Drawings or directed by the Engineer.

3.7 MAINTENANCE OF PROTECTIVE MEASURES

- A. Maintain protective measures throughout the construction process. Immediately repair any alteration to protection measures throughout construction process. Repair or reinstall protective measures immediately upon alteration. Monitor protective measures daily.
- B. Remove and clear area of debris and fencing, barricades, etc., upon final written approval of Engineer.

END OF SECTION

**SECTION 01 66 00
DELIVERY, STORAGE AND HANDLING**

PART 1 GENERAL

1.1 GENERAL:

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

1.2 TRANSPORTATION AND DELIVERY:

- A. Transport and handle items in accordance with manufacturer's printed instructions.
- B. Schedule delivery to reduce long term on-site storage prior to installation and/or operation. Under no circumstances shall equipment be delivered to the site more than one month prior to installation without written authorization from the Engineer.
- C. Ship equipment, material and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
- D. Pack spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.
- E. Deliver spare parts at same time as pertaining equipment. Deliver spare parts to owner after completion of work.
- F. Coordinate delivery with installation to ensure minimum holding time for items that are hazardous, flammable, easily damaged or sensitive to deterioration.
- G. Deliver products to the site in manufacturer's original sealed containers or other packing systems, complete with instructions for handling, storing, unpacking, protecting and installing.
- H. Assume responsibility for equipment material and spare parts just before unloading from carrier at site.
- I. All items delivered to the site shall be unloaded and placed in a manner which will not hamper the Contractor's normal construction operation or those of subcontractors and other contractors and will not interfere with the flow of necessary traffic.
- J. Provide equipment and personnel to unload all items delivered to the site.
- K. Promptly inspect shipment to assure that products comply with requirements, quantities are correct, and items are undamaged.

- L. Pay all demurrage charges if failed to promptly unload items.

1.3 STORAGE AND PROTECTION:

- A. Store and protect products and equipment in accordance with the manufacturer's instructions, with seals and labels intact and legible. Instructions shall be carefully followed and a written record of this kept by the Contractor for each product and pieces of equipment.
- B. Arrange storage of products and equipment to permit access for inspection. Periodically inspect to make sure products and equipment are undamaged and are maintained under specified conditions.
- C. Provide protective maintenance during storage consisting of manually exercising equipment, inspecting mechanical surfaces for signs or corrosion or other damage, lubricating, applying any coatings as recommended by the equipment manufacturer necessary for its protection and all other precautions to assure proper protection of all equipment stored and for compliance with manufacturers' requirements related to warranties. Log all protective maintenance for each piece of equipment in the written record noted above.
- D. Store loose granular materials on solid flat surface in a well-drained area. Prevent mixing with foreign matter.
- E. Cement and lime shall be stored under a roof and off the ground and shall be kept completely dry at all times. All structural, miscellaneous and reinforcing steel shall be stored off the ground or otherwise to prevent accumulation of dirt or grease, and in a position to prevent accumulations of standing water and to minimize rusting. Beams shall be stored with the webs vertical. Precast concrete shall be handled and stored in a manner to prevent accumulations of dirt, standing water, staining, chipping or cracking. Brick, block and similar masonry products shall be handled and stored in manner to reduce breakage, cracking and spalling to a minimum.
- F. All mechanical and electrical equipment and instruments shall be covered with canvas and stored in a weathertight building to prevent injury. The building may be a temporary structure on the site or elsewhere, but it shall be satisfactory to the Engineer and Owner. Building shall be provided with adequate ventilation to prevent condensation. Maintain temperature and humidity within range required by manufacturer and to prevent condensation on the equipment being stored.
 - 1. All equipment shall be stored fully lubricated with oil, grease and other lubricants unless otherwise instructed by the manufacturer.

2. Moving parts shall be rotated a minimum of once weekly to insure proper lubrication and to avoid metal-to-metal "welding". Log all rotation maintenance for each piece of equipment in the written record noted above.
3. Upon installation of the equipment, the Contractor shall start the equipment, at least half load, once weekly for an adequate period of time to ensure that the equipment does not deteriorate from lack of use. Log all startup for each piece of equipment in the written record noted above.
4. Lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment at the time of acceptance.
5. Prior to acceptance of the equipment, the Contractor shall have the manufacturer inspect the equipment and certify that its condition has not been detrimentally affected by the long storage period. Such certifications by the manufacturer shall be deemed to mean that the equipment is judged by the manufacturer to be in a condition equal to that of equipment that has been shipped, installed, tested and accepted in a minimum time period. As such, the manufacturer will guaranty the equipment equally in both instances. If such a certification is not given, the equipment shall be judged to be defective. It shall be removed and replaced at the Contractor's expense.
6. Contractor shall assume responsibility for protection and storage of equipment and material.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field engineering.
- B. Closeout procedures.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Testing, adjusting, and balancing.
- F. Project record documents.
- G. Operation and maintenance data.
- H. Manual for materials and finishes.
- I. Manual for equipment and systems.
- J. Spare parts and maintenance products.
- K. Product warranties and product bonds.
- L. Maintenance service.
- M. Examination.
- N. Preparation.
- O. Execution.
- P. Cutting and patching.
- Q. Protecting installed construction.
- R. Final cleaning.

1.2 FIELD ENGINEERING

- A. Employ land surveyor registered in State of Washington and acceptable to Engineer.
- B. Locate and protect survey control and reference points. Promptly notify Engineer of discrepancies discovered.
- C. Control datum for survey is indicated on Drawings.
- D. Not used.

- E. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- F. Provide field engineering services. Establish elevations, lines, and levels using recognized engineering survey practices.
- G. Submit copy of Site drawing signed by land surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.
- H. Maintain complete and accurate log of control and survey Work as Work progresses.
- I. Not used.
- J. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- K. Promptly report to Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- L. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Engineer.
- M. Not used.

1.3 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
 - 1. Submit maintenance manuals, Project record documents, digital images of construction photographs, and other similar final record data in compliance with this Section.
 - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
 - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
 - 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
 - 5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
 - 6. Make final change-over of locks eliminating construction master-key system and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.
 - 7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.

8. Perform final cleaning according to this Section.
- B. Substantial Completion Inspection:
1. When Contractor considers Work to be substantially complete, submit to Owner:
 - a. Written certificate that Work, or designated portion, is substantially complete.
 - b. List of items to be completed or corrected (initial punch list).
 2. Within seven days after receipt of request for Substantial Completion, Owner will make inspection to determine whether Work or designated portion is substantially complete.
 3. Should Owner determine that Work is not substantially complete:
 - a. Owner will promptly notify Contractor in writing, stating reasons for its opinion.
 - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Owner.
 - c. Owner will reinspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Owner's inspection.
 4. When Owner finds that Work is substantially complete, Owner will:
 - a. Prepare Certificate of Substantial Completion on EJCDC C-625 - Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Engineer and Owner (final punch list).
 - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
 5. After Work is substantially complete, Contractor shall:
 - a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
 - b. Complete Work listed for completion or correction within time period stipulated.
 6. Owner will occupy all of building as specified in Section 01 10 00 – Summary of Work.
- C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.
1. When Contractor considers Work to be complete, submit written certification that:
 - a. Contract Documents have been reviewed.
 - b. Work has been examined for compliance with Contract Documents.
 - c. Work has been completed according to Contract Documents.

- d. Work is completed and ready for final inspection.
2. Submittals: Submit following:
- a. Final punch list indicating all items have been completed or corrected.
 - b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
 - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
 - d. Accounting statement for final changes to Contract Sum.
 - e. Contractor's affidavit of payment of debts and claims.
 - f. Contractor affidavit of release of liens.
 - g. Consent of surety to final payment.
3. Perform final cleaning for Contractor-soiled areas according to this Section.
- D. Final Completion Inspection:
- 1. Within seven days after receipt of request for final inspection, Owner will make inspection to determine whether Work or designated portion is complete.
 - 2. Should Owner consider Work to be incomplete or defective:
 - a. Owner will promptly notify Contractor in writing, listing incomplete or defective Work.
 - b. Contractor shall remedy stated deficiencies and send second written request to Owner that Work is complete.
 - c. Owner will reinspect Work.
 - d. Redo and Inspection of Deficient Work: Repeated until Work passes Owner's inspection.

1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Owner seven days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by Equipment or System Manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.

- F. Execute startup under supervision of Manufacturer's representative or Contractors' personnel according to Manufacturer's instructions.
- G. When specified in individual Specification Sections, require Manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.
- H. Submit a written report according to Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project equipment instructed by authorized Manufacturer's representative who is knowledgeable about the Project.
- C. Video Recordings: Provide high-quality color video recordings of demonstration and instructional sessions. Engage commercial videographer to record sessions. Include classroom instructions, demonstrations, board diagrams, and other visual aids. Include menu navigation.
- D. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- E. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- F. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time, at equipment location.
- G. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- H. Required instruction time for each item of equipment and system is specified in individual Specification Sections.

1.6 TESTING, ADJUSTING, AND BALANCING

- A. Owner will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services from cash allowance specified in Section 01 22 00 – Unit Price Measurement and Payment.
- B. Independent firm will perform services specified in Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- C. Reports will be submitted by independent firm to Engineer indicating observations and results of tests and indicating compliance or noncompliance with requirements of Contract Documents.

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 used.
 - 3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
 - 1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
 - 2. Include locations of concealed elements of the Work.
 - 3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
 - 4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
 - 5. Identify and locate existing buried or concealed items encountered during Project.
 - 6. Measured depths of foundations in relation to finish main floor datum.
 - 7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 9. Field changes of dimension and detail.
 10. Details not on original Drawings.
- G. Submit PDF electronic files of marked-up documents to Engineer before Substantial Completion.

1.8 OPERATION AND MAINTENANCE DATA

- A. Submit in PDF composite electronic indexed file.
- B. Submit data bound in 8-1/2 x 11-inch (A4) text pages, three D side ring binders with durable plastic covers.
- C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.
- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
 1. Part 1: Directory, listing names, addresses, and telephone numbers of Engineer, Contractor, Subcontractors, and major equipment suppliers.
 2. Part 2: Operation and maintenance instructions, arranged by process flow and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
 - a. Significant design criteria.
 - b. List of equipment.
 - c. Parts list for each component.
 - d. Operating instructions.
 - e. Maintenance instructions for equipment and systems.
 - f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
 - g. Safety precautions to be taken when operating and maintaining or working near equipment.
 3. Part 3: Project documents and certificates, including the following:

- a. Shop Drawings and product data.
- b. Air and water balance reports.
- c. Certificates.
- d. Originals of warranties and bonds.

1.9 MANUAL FOR MATERIALS AND FINISHES

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

1.10 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

- C. Submit one copy of completed volumes before Substantial Completion. Draft copy will be reviewed and returned after Substantial Completion, with Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes within ten days after final inspection.
- E. Submit in PDF composite electronic indexed file of final manual within ten days after final inspection.
- F. Each Item of Equipment and Each System: Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- G. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; by label machine.
- H. Include color-coded wiring diagrams as installed.
- I. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.
- J. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- K. Include servicing and lubrication schedule and list of lubricants required.
- L. Include Manufacturer's printed operation and maintenance instructions.
- M. Include sequence of operation by Controls Manufacturer.
- N. Include original Manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- O. Include control diagrams by Controls Manufacturer as installed.
- P. Include Contractor's coordination drawings with color-coded piping diagrams as installed.
- Q. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- R. Include list of original Manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- S. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.
- T. Additional Requirements: As specified in individual product Specification Sections.
- U. Include listing in table of contents for design data with tabbed dividers and space for insertion of data.

1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.
- B. Deliver to Project Site and place in location as directed by Owner; obtain receipt prior to final payment.

1.12 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten days after completion of applicable item of Work.
- B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.
- D. Co-execute submittals when required.
- E. Include table of contents and assemble in three D side ring binder with durable plastic cover.
- F. Submit prior to final Application for Payment.
- G. Time of Submittals:
 - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
 - 2. Make other submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
 - 3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

1.13 MAINTENANCE SERVICE

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

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 EXECUTION

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

- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
 - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
 - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
 - 1. Refer questionable mounting heights choices to Engineer for final decision.
 - 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by Manufacturer.

3.4 CUTTING AND PATCHING

- A. Employ **skilled and experienced** installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
 - 1. Structural integrity of element.
 - 2. Integrity of weather-exposed or moisture-resistant elements.
 - 3. Efficiency, maintenance, or safety of element.
 - 4. Visual qualities of sight-exposed elements.
 - 5. Work of Owner or separate contractor.
- C. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
 - 1. Fit the several parts together, to integrate with other Work.
 - 2. Uncover Work to install or correct ill-timed Work.
 - 3. Remove and replace defective and nonconforming Work.
 - 4. Remove samples of installed Work for testing.
 - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.

- F. Restore Work with new products according to requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated material, to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Engineer for decision or remedy.

3.5 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from Waterproofing or Roofing Material Manufacturer.
- F. Prohibit traffic from landscaped areas.

3.6 FINAL CLEANING

- A. Not used.
- B. Execute final cleaning prior to final Project assessment.
 - 1. Employ experienced personnel or professional cleaning firm.
- C. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces.
- D. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- E. Replace filters of operating equipment.
- F. Clean debris from roofs, gutters, downspouts, and drainage systems.
- G. Clean Site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION

SECTION 01 75 00
TESTING, TRAINING, AND COMMISSIONING

PART 1 GENERAL

1.1 SCOPE

This section specifies equipment and system testing and start-up, services of Manufacturer's representatives, training of Owner's personnel, and final testing requirements for the complete facility.

1.2 CONTRACT REQUIREMENTS

- A. Testing, training, and start-up are requisite to the satisfactory completion of the Contract.
- B. Complete all testing, training, and start-up within the Contract Time(s).
- C. Furnish all necessary labor, power, chemicals, tools, equipment, instruments, and services required for and incidental to completing functional testing, performance testing, and operational testing.
- D. Provide competent, experienced technical representatives of Equipment Manufacturers for assembly, installation, testing, and operator training.

1.3 START-UP PLAN

- A. Submit start-up plan for each piece of equipment and each system not less than 2 weeks prior to planned initial equipment or system start-up.
- B. Provide detailed Start-up Progress Schedule with the following activities identified:
 - 1. Manufacturer's services
 - 2. Installation certifications
 - 3. Operator training
 - 4. Submission of operation and maintenance manual
 - 5. Functional testing
 - 6. Performance testing
 - 7. Operational testing

- C. Provide testing plan with test logs for each item of equipment and/or system. Include testing of alarms, control circuits, capacities, speeds, flows, pressures, vibrations, sound levels, and other parameters.
- D. Provide summary of shutdown requirements for existing systems if required, which are necessary to complete start-up of new equipment and systems.
- E. Revise and update start-up plan based upon review comments, actual progress, or to accommodate changes in the sequence of activities.

1.4 GENERAL START-UP AND TESTING PROCEDURES

A. Air Barrier Building Test

1. Complete air barrier building testing in accordance with the Washington State Energy Code, Section C402.5.1.2.3.
2. Air barrier test report shall be submitted to Engineer once test is complete
3. If test results exceed 0.25 cfm/ft² at 0.3 in wg, then visually inspect air barrier and seal noted sources of leakage.
4. Submit a follow-up report to jurisdiction noting corrective measures taken.

B. Mechanical Systems:

1. Remove rust preventatives and oils applied to protect equipment during construction.
2. Flush lubrication systems and dispose of flushing oils. Recharge lubrication system with lubricant recommended by Manufacturer.
3. Flush fuel system and provide fuel for testing and start-up.
4. Install and adjust packing, mechanical seals, O-rings, and other seals. Replace defective seals.
5. Remove temporary supports, bracing, or other foreign objects installed to prevent damage during shipment, storage, and erection.
6. Check rotating machinery for correct direction of rotation and for freedom of moving parts before connecting driver.
7. Perform cold alignment and hot alignment to Manufacturer's tolerances.
8. Adjust V-belt tension and variable pitch sheaves.

9. Inspect hand and motorized valves for proper adjustment. Tighten packing glands to ensure no leakage but permit valve stems to rotate without galling. Verify valve seats are positioned for proper flow direction.
 10. Tighten leaking flanges or replace flange gasket. Inspect screwed joints for leakage.
 11. Install gratings, safety chains, handrails, shaft guards, and sidewalks prior to operational testing.
- C. Electrical Systems
1. Perform insulation resistance tests on wiring except 120-volt lighting, wiring, and control wiring inside electrical panels.
 2. Perform continuity tests on grounding systems.
 3. Test and set switchgear and circuit breaker relays for proper operation.
 4. Perform direct current high potential tests on all cables that will operate at more than 2,000 volts. Obtain services of independent testing lab to perform tests.
 5. Check motors for actual full load amperage draw. Compare to nameplate value.
- D. Instrumentation Systems
1. Bench or field calibrate instruments and make required adjustments and control point settings.
 2. Leak test pneumatic controls and instrument air piping.
 3. Energize transmitting and control signal systems, verify proper operation, ranges, and settings.

1.5 FUNCTIONAL TESTING

- A. Functionally test mechanical and electrical equipment for proper operation after general start-up and testing tasks have been completed.
- B. Demonstrate proper rotation, alignment, speed, flow, pressure, vibration, sound level, adjustments, and calibration. Perform initial checks in the presence of and with the assistance of the Manufacturer's representative.
- C. Demonstrate proper operation of each instrument loop function including alarms, local and remote controls, instrumentation, and other equipment functions. Generate signals with test equipment to simulate operating conditions in each control mode.

- D. Conduct continuous 8-hour test under full load conditions. Replace parts which operate improperly.

1.6 CERTIFICATE OF PROPER INSTALLATION

- A. At completion of functional testing, furnish written report prepared and signed by Manufacturer's authorized representative, certifying equipment:
 - 1. Has been properly installed, aligned, adjusted, and lubricated.
 - 2. Is free of any stresses imposed by connecting piping or anchor bolts.
 - 3. Is suitable for satisfactory full-time operation under full load conditions.
 - 4. Operates within the allowable limits for vibration.
 - 5. Controls, protective devices, instrumentation, and control panels furnished as part of the equipment package are properly installed, calibrated, and functioning.
 - 6. Control logic for start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly functioning.
- B. Furnish written report prepared and signed by the electrical and/or instrumentation subcontractor certifying:
 - 1. Motor control logic that resides in motor control centers, control panels, and circuit boards furnished by the electrical and/or instrumentation subcontractor has been calibrated and tested and is properly operating.
 - 2. Control logic for equipment start-up, shutdown, sequencing, interlocks, and emergency shutdown has been tested and is properly operating.
- C. Co-sign the reports along with the Manufacturer's representative and subcontractors.

1.7 TRAINING OF OWNER'S PERSONNEL

- A. Provide operations and maintenance training for items of mechanical, electrical, and instrumentation equipment. Utilize Manufacturer's representatives to conduct training sessions.
- B. Coordinate training schedule with City staff. Coordinate training sessions to prevent overlapping sessions. Arrange sessions so that individual operators and maintenance technicians do not attend more than two sessions per week.
- C. Provide Operation and Maintenance Manual for specific pieces of equipment or systems 2 weeks prior to training session for that piece of equipment or system.

- D. Satisfactorily complete functional testing before beginning operator training.
- E. The Owner may videotape the training for later use with the Owner’s personnel.

1.8 MINIMUM SERVICE SCHEDULE

Minimum services as specified shall be provided in accordance with the following schedule:

Specification Section	Equipment	Minimum On-Site Time Requirements		
		1) Equipment Installation	2) Equipment Testing	3) Operator Training
23 19 13	Instrumentation and Control Devices for HVAC	0.5 CWD	1 CWD	0.5 CWD
23 34 00	HVAC Fans	0.5 CWD	1 CWD	0.5 CWD
23 81 40	Heat Pumps	0.5 CWD	1 CWD	0.5 CWD
26 24 19	Motor Control Centers	1 CWD	2 CWD	1 CWD
26 29 24	Active Front End Variable-Frequency Controllers	1 CWD	2 CWD	1 CWD
26 32 13	Diesel-Engine Generators	1 CWD	2 CWD	1 CWD
26 36 23	Automatic Transfer Switch	1 CWD	2 CWD	0.5 CWD
40 05 51.15	Gate Valves	0.5 CWD	1 CWD	0.5 CWD
40 05 51.24	Check Valves	0.5 CWD	1 CWD	0.5 CWD
40 05 67.39	Pressure-Relief Valves	0.5 CWD	1 CWD	0.5 CWD
40 05 78	Miscellaneous Valves	0.5 CWD	1 CWD	0.5 CWD
40 61 13	Process Control Systems	1 CWD	2 CWD	2 CWD
40 71 13	Magnetic Flow Meters	0.5 CWD	0.5 CWD	0.5 CWD
40 72 43	Pressure Level Measurement Devices	0.5 CWD	0.5 CWD	0.5 CWD
40 75 21	Chlorine Analyzers	0.5 CWD	1 CWD	0.5 CWD
43 21 00	Liquid Pumps	1 CWD	2 CWD	0.5 CWD
43 21 10	Vertical Turbine Pumps	1 CWD	2 CWD	2 CWD

43 21 39	Deep Well Submersible Pumps	1 CWD	2 CWD	2 CWD
46 30 00	Chemical Feed Pumps	0.5 CWD	1 CWD	0.5 CWD
46 33 13	Sodium Hypochlorite Generating Equipment	1 CWD	2 CWD	1 CWD
46 33 14	Self-Contained Fluoride Upflow Saturator	1 CWD	2 CWD	1 CWD

NOTE: CWD is defined as a consecutive working day consisting of 8 hours each from 8:00 a.m. to 5:00 p.m.

1.9 OPERATIONAL TESTING

- A. Conduct operational test of the entire facility after completion of operator training. Demonstrate satisfactory operation of equipment and systems in actual operation.
- B. Conduct operational test for continuous 7-day period.
- C. Owner will provide operations personnel, power, fuel, and other consumables for duration of test.
- D. Immediately correct defects in material, workmanship, or equipment which became evident during operational test.
- E. Repeat operational test when malfunctions or deficiencies cause shutdown or partial operation of the facility or results in performance that is less than specified.

1.10 RECORD KEEPING

- A. Maintain and submit to Engineer the following records generated during start-up and testing phase of Project:
 1. Daily logs of equipment testing identifying all tests conducted and outcome.
 2. Logs of time spent by Manufacturer's representatives performing services on the job site.
 3. Equipment lubrication records.
 4. Electrical phase, voltage, and amperage measurements.
 5. Insulation resistance measurements.
 6. Pump torsional and lateral vibration analysis report.

7. Data sheets of control loop testing including testing and calibration of instrumentation devices and set points.

END OF SECTION

SECTION 01 78 23
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes procedural requirements for providing, compiling, and submitting operation and maintenance data required for this Project.

1.2 SUMMARY

- A. This section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. General contents of data.
 - 2. Specific data for each equipment and system.
 - 3. Manual for materials and finishes.
 - 4. Assembly.

1.3 DEFINITIONS

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

1.4 SUBMITTALS

- A. O&M Manual Content: Operations and maintenance manual submittal requirements are specified in individual Specification Sections for the Products for which they must be supplied. Submit reviewed manual content formatted and organized by this Section and as defined in Section 01 33 00.
 - 1. Engineer will comment on whether content of operations and maintenance submittals are acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Manual Submittal: Submit an electronic copy of each manual in final form prior to requesting inspection for Substantial Completion and as defined in Section 01 33 00. Engineer will return an electronic copy with comments.

1. The Contractor to correct or revise each manual to comply with Engineer's comments.
- C. Submit one electronic copy of each corrected manual as a final manual within 15 days of receipt of Engineer's comments and prior to commencing startup, commissioning, and/or training.
- D. After acceptance, deliver one electronic copy and 3 hard copies to the Engineer.

1.5 FORMAT (HARDCOPY)

- A. Prepare data in the form of an O&M instructional manual.
- B. Binders: Commercial quality, 8-1/2 x 11-inch three-hole post type binders with hardback, 3-inch maximum binder size. When multiple binders are used, correlate data into related consistent groupings. Three ring binders are not acceptable.
- C. Arrange contents by Specification Section numbers and sequence of Table of Contents of this Project Manual.
- D. Provide tabbed fly leaf for each separate product and system, with printed description of product and major component parts of equipment. Insert type tab labels must be secured or bonded to prevent the labels from falling out.
- E. Text: Manufacturer's printed data, or typewritten data on 20-pound paper.
- F. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages and insert into clear plastic envelopes that can be secured into the three-hole post binders.

1.6 FORMAT (ELECTRONIC DOCUMENTATION)

- A. The Contractor must provide Operation and Maintenance Manual information specific to the configuration of the Project in electronic form that is substantively the same as that hard copy materials. Documents should be formatted like a web site complete with index page and Table of Contents. The electronic format must be such that the Owner is able to load the files onto a server to provide online access via any standard web browser. The Contractor shall make use of HTML (for text-based documents) and PDF (for CAD type drawings) file formats. The complete document shall be provided on a flash drive.
- B. The electronic O&M data must be organized in a logical manner to aid operation in troubleshooting and information retrieval.

1.7 QUALITY ASSURANCE

- A. Preparation of data shall be performed by personnel:
 - 1. Trained and experienced in O&M of described equipment.
 - 2. Familiar with requirements of this section.
 - 3. Skilled as technical writers to the extent required to communicate the essential data to the Reader.
 - 4. Skilled as drafters competent to prepare any required drawings.

1.8 SUPPLEMENTS

- A. The supplements listed below, following "END OF SECTION" are part of this Specification.
 - 1. 01 78 23A, Contractor Submittal Form
 - 2. 01 78 23B, Equipment Data Form

PART 2 PRODUCTS- (Not Used)

PART 3 EXECUTION

3.1 GENERAL CONTENTS OF DATA

- A. Each individual manual shall contain equipment data pertaining to not more than one Specification section number as indicated in the Contract Documents.
 - 1. Completed Contractor Submittal Form (01 78 23A). An electronic copy of the form can be provided to the Contractor upon request
- B. Title Sheet: First page in data listing following:
 - 1. Title: "OPERATION AND MAINTENANCE INSTRUCTIONS".
 - 2. Title of Project: As shown on Contract Documents.
 - 3. Name(s) of applicable building(s) or structure(s) in which equipment is located.
 - 4. Name of equipment as described in Contract Documents.
 - 5. Contractor's name, address, and telephone number.

6. Subcontractor's name, address, and telephone number if equipment is provided by Subcontractor.
 7. Contractor's or Subcontractor's purchase order number, Manufacturer's shop order number or other such numbers required for parts and service ordering.
 8. Manufacturer's name, address, and telephone number.
 9. Name, address, and telephone number for local source of supply for parts and service.
- C. Equipment List: Immediately following title sheet containing the following:
1. Table of Contents: Immediately following equipment list. Arrange in logical, systematic order and shall include as minimum each tabbed divider. Each page shall be numbered.
 2. Tabbed Dividers: Insert tabbed section dividers between each major section
 - a. Provide title of section on each tab.
 - b. Provide table of contents for each tabbed section, arranged in systematic order.
 3. Equipment Data Sheets: Provide catalog sheets showing configuration, Manufacturer's specifications, models, options, and styles of equipment and major components being provided. Product data sheets will show project specific information with inapplicable information deleted by crossing out or removal. Include in tabbed section(s).
 4. Text:
 - a. Include only those sheets applicable to Project.
 - b. Each sheet shall:
 - 1) Identify specific equipment or part installed.
 - 2) Identify text applicable to equipment or part installed.
 - 3) Do not include inapplicable information or neatly strike it out.
 5. Drawings:
 - a. Supplement text with drawings to clearly illustrate following:
 - 1) Equipment and components.

- 2) Relations of component parts of equipment and systems.
 - 3) Control and flow diagrams.
 - b. Actual drawings of equipment from Manufacturer. "Typical" drawings are not acceptable unless they accurately illustrate actual installation for this contract.
6. Specially written information, as required to supplement text for particular installation.
- a. Provide explanation of interrelationships of equipment and components, and effects one component has on another or entire system.
 - b. Provide overall instructions and procedures for equipment tying in instructions and procedures for separate components into unified instructional package.
 - c. Provide glossary of any special terms used by the Manufacturer if applicable.
 - d. Organize in consistent format under separate headings for different O&M procedures.
 - e. Provide logical sequence of instructions in order of O&M action required for each procedure.

3.2 SPECIFIC DATA FOR EACH ITEM AND/OR SYSTEM

- A. For each item of equipment and system include:
- 1. Completed Equipment Data Form (01 78 23B). An electronic copy of the form can be provided to the Contractor upon request.
 - 2. Description of equipment and component parts:
 - a. Function
 - b. Normal operating characteristics
 - c. Limiting conditions.
 - d. Performance curves
 - e. Engineering data
 - f. Test as applicable.
 - g. Complete nomenclature and model number of replaceable parts including keyed labeled exploded diagram.

- h. Complete nameplate data.
 - i. Owner's tag (or asset) numbers for equipment as indicated on the Contract Drawings.
3. Operating Procedures:
- a. Startup and break-in.
 - b. Normal operating instructions.
 - c. Regulation and control
 - d. Stopping and shutdown,
 - e. Emergency instructions.
 - f. Summer and winter operating instructions, as applicable.
 - g. Special operating instructions.
4. Maintenance Procedures:
- a. Routine maintenance operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, repair, and reassembly instructions.
 - d. Alignment, adjusting, and checking instructions.
5. Servicing and Lubrication Schedule:
- a. List of lubricants required and quantity to be applied.
 - b. Schedule of lubrication.
 - c. Schedule for other routine maintenance.
6. Manufacturer's printed instructions regarding safety precautions for both (a) protection of personnel operating equipment and systems and (b) prevention of damage to equipment and systems.
7. Description of sequence of operation of controls.
8. Assembly drawings and diagrams required for maintenance.
9. Manufacturer's parts list and illustrations

- a. Predicted life of parts subject to wear.
 - b. Items recommended to be stocked by the Owner as spare parts and quantities of same.
10. Accepted control diagrams such as ladder diagrams, instrumentation loop diagrams, and electrical schematics.
11. Bill of material.
12. Other data as required under applicable Specification sections.
- B. Each electric and electronic system, as applicable to equipment such as switchgear, motor control centers, panel boards, switchboards, starters, breakers, and relays shall include:
1. Description of System and Component Parts:
 - a. Function
 - b. Normal operating characteristics
 - c. Limiting conditions.
 - d. Performance curves
 - e. Engineering data
 - f. Rating tables
 - g. Tests, as applicable.
 - h. Complete nomenclature and model number of replaceable parts.
 - i. Complete nameplate data.
 - j. Owner's Tag (asset) numbers for equipment as indicated on the Contract Drawings.
 2. Circuit Directories of Panel Boards:
 - a. Electrical service.
 - b. Controls.
 - c. Communications.
 3. Complete instrumentation

- a. Loop diagrams
 - b. Tabulated listing of components in each control circuit or loop.
4. Operating Procedures:
- a. Routine and normal operating instructions.
 - b. Sequences required.
 - c. Special operating instructions.
5. Maintenance Procedures:
- a. Routine maintenance operations.
 - b. Guide to troubleshooting.
 - c. Disassembly, repair, and reassembly instructions.
 - d. Adjustment and checking instructions.
6. Manufacturer's printed instructions regarding safety precautions for both:
- a. Protection of personnel operating equipment and systems.
 - b. Prevention of damage to equipment and systems.
7. List of original all of the Manufacturer's components, spare parts with diagram, and recommended quantities to be maintained in storage by the Owner.
8. Other data as required under pertinent sections of Specifications.
- C. Prepare and include additional data when need for such data becomes apparent during instruction of Owner's personnel. Differences between the equipment O&M manual and the Manufacturer's training session shall result in the training and/or O&M Manual being corrected.

3.3 MANUAL FOR MATERIAL AND FINISHES

- A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Include Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

- C. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional Requirements: As specified in individual product specification sections.
- E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

3.4 ASSEMBLY

- A. Assemble in 3 sets.
- B. Remove bindings of individual manuals.
- C. Insert index tabs labeled with the respective piece of equipment to separate individual manuals.
- D. Provide a Table of Contents at the front of each volume showing the equipment items in the order in which they appear in the volume. Each equipment items shall include the functional name, applicable specifications section, and the plan listing, if any.
- E. The preventive maintenance schedule shall be bound in the front of each section immediately following the index tab sheet. The schedule shall be identified with respect to the piece of equipment it is referring to.
- F. Sheet Size: 8-1/2 x 11 sheets.
- G. Drawings may be on 11 x 17-inch sheets folded to 8-1/2 x 11 inches.
- H. Engrave on covers and end of binder, title OPERATIONS AND MAINTENANCE INSTRUCTIONS, name of Project, Owner's project number, date of Contract, and volume number with subject matter of contents, and Engineer's name.

END OF SECTION

01 78 23A

CONTRACTOR SUBMITTAL FORM

TO: (Engineer) (Address) (City, State, Zip) (Attn:)	DATE:	
	SPECIFICATION SECTION TITLE:	
	SECTION NO.:	
	MANUFACTURER/ VENDOR:	
FROM: (Contractor) (Address) (City, State, Zip)	NO. OF COPIES SUBMITTED TO ENGINEER:	
	SIGNATURE OF CONTRACTOR:	
<p>GENTLEMEN:</p> <p>We have checked the O&M manual submittal dated _____, 20__, and have found it to be in accordance with the requirements of Specification Section 01 78 23 as noted below.</p>		
<p>FORMAT</p> <p>Size: 8-1/2 x 11 or 11 x 17</p> <p>Paper: 20-lb minimum</p> <p>Text: Printed data/neatly typed</p> <p>Drawings: Standard size bound in text; in text-size labeled envelopes</p> <p>Tabbed Section Dividers</p> <p>Cover Label: Title</p> <p>Project name</p> <p>Building/structure ID</p> <p>Equipment name</p> <p>Specification section</p> <p>Binders: 3-ring</p>		

CONTRACTOR SUBMITTAL FORM

Provided	Not Applicable	Page No.	
3.01 GENERAL CONTENTS			
			A. Section number - one specification only
			B. Title Page
			1. Title
			2. Project title
			3. Building/structure ID
			4. Equipment name
			5. Contractor ID
			6. Subcontractor ID
			7. Purchase order data
			8. Manufacturer ID
			9. Service/parts supplier ID
			C. Product List
			D. Table of Contents
			E. Tabbed Sections
			F. Pertinent data sheets
			1. Annotated as needed
			G. Text
			1. Pertinent to project
			2. Annotated
			H. Drawings
			1. Supplement text
			a. Illustrate product and components
			b. Relations of equipment systems
			c. Control and flow diagrams
			2. Actual drawing of project equipment

CONTRACTOR SUBMITTAL FORM

Provided	Not Applicable	Page No.	
3.01 GENERAL CONTENTS			
			I. Special Information
			1. Interrelationships of equipment and components
			2. Instructions and procedures provided
			3. Instructions organized in consistent format
			4. Instructions in logical sequence
			5. Glossary
			J. Warranty, Bond, Service Contract
3.02 SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			A. For each item of equipment
			1. Complete Form 2 to Section 01 78 23
			2. Description of Unit and Components
			a. Equipment functions
			b. Normal operating characteristics
			c. Limiting conditions
			d. Performance curves
			e. Engineering data
			f. Test data
			g. Replaceable parts list (with numbers)
			h. Nameplate data
			i. P&ID numbers
			3. Operating Procedures
			a. Startup, break-in
			b. Routine/normal operation
			c. Regulation and control
			d. Stopping and shutdown
			e. Emergency

Provided	Not Applicable	Page No.	
3.02 SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			3. Operating Procedures (continued)
			f. Seasonal operation
			g. Special instructions
			4. Maintenance Procedures
			a. Routine/normal instructions
			b. Troubleshooting guide
			c. Disassembly/repair/assembly
			d. Alignment, adjusting and checking instructions
			5. Servicing and Lubrication
			a. List of lubricants
			b. Lubrication schedule
			c. Maintenance schedule
			6. Safety Precautions/Features
			7. Sequence of Operation of Controls
			8. Assembly Drawings
			9. Parts List and Illustrations
			a. Predicted life
			b. Spare parts list
			10. Control Diagrams/Schematics
			11. Bill of Materials
			12. Other Data as Required

CONTRACTOR SUBMITTAL FORM

Provided	Not Applicable	Page No.	
3.02 SPECIFIC CONTENTS (EQUIPMENT/SYSTEMS ONLY)			
			B. Each electrical and electronic system
			1. Description
			a. Equipment functions
			b. Normal operating characteristics
			c. Performance curves
			d. Engineering data
			e. Test data
			f. Replaceable parts list (with numbers)
			g. Nameplate data
			h. P&ID numbers
			2. Circuit and Panel Board Directories
			a. Electrical
			b. Controls
			c. Communications
			3. Instrumentation
			a. Loop Diagrams
			b. Components list each circuit/loop
			4. Operation Procedures
			a. Routine/normal operating instructions
			b. Sequences required
			c. Special operating instruction
			5. Maintenance Procedures
			a. Routine/normal instructions
			b. Troubleshooting guide
			c. Disassembly/reassembly
			d. Adjusting and checking
			6. Safety Precautions/Features
			7. Spare Parts List
			8. Additional Data

01 78 23B

EQUIPMENT DATA FORM

PROJECT NAME			
CONTRACT NO.			
CONTRACTOR			
EQUIPMENT NO.		ASSET NO.*	
DESCRIPTION		MAINT. NO.*	
LOCATION			
MANUFACTURER			
PURCHASED FROM			
VENDOR ORDER NO.		PURCHASE \$	
DATE OF PURCHASE			
LOCAL SUPPLIER			
ADDRESS			
PHONE NO.			
MODEL NO.			
NO. OF UNITS		SERIAL NOS.	
*By Owner			

EQUIPMENT DATA FORM

Page 2 of 4

NAMEPLATE DATA			
ELECTRIC MOTOR		PUMP/HVAC UNIT	
MANUFACTURER		MANUFACTURER	
TYPE	[] AC [] DC	TYPE	
HORSEPOWER		SIZE	
RPM		CAPACITY	
VOLTAGE		PRESSURE	
AMPERAGE		ROTATION	
PHASE		IMPELLER SIZE	
FRAME		IMPELLER MATERIAL	
DRIVE/REDUCER		OTHER (I&C)	
MANUFACTURER		MANUFACTURER	
TYPE	[] GEAR [] V-BELT [] CHAIN [] VARIDRIVE	TYPE	
		SIZE	
SERVICE FACTOR		CAPACITY	
RATIO		RANGE	

LUBRICANT/RECOMMENDED SPARE PARTS LIST				
EQUIPMENT NO.		ASSET NO.*		
DESCRIPTION		MAINT. NO.*		
LUBRICANT LIST				
REFERENCE SYMBOL	LUBRICANT TYPE (MILITARY STANDARD)	RECOMMENDED LUBRICANT AND MANUFACTURER		
List symbols in "Maintenance Operation" (Page 3).	List general lubricant type.	List specific lubricant name, viscosity, and Manufacturer.		
RECOMMENDED SPARE PARTS LIST				
PART NO. **	DESCRIPTION	UNIT	QUANTITY	UNIT COST
ADDITIONAL DATA AND REMARKS				
* By Owner ** Identify parts provided by this contract with two asterisks. Note: Attach additional sheets if necessary; identify each sheet at top with equipment number and description.				

**SECTION 02 30 00
SUBSURFACE INVESTIGATION**

PART 1 GENERAL

1.1 SUMMARY

- A. Subsurface investigations and reporting have been performed for the purpose of obtaining data for the planning and design of this Project. Copies of such reporting are attached to the Contract Documents as Supplementary Information.

1.2 LIMITATIONS

- A. The subsurface investigations and reporting are being made available solely for the convenience of the Bidder and shall not relieve the Bidder or the Contractor of any risk, duty to make examinations and investigations as required by the Contract Documents.
- B. It is mutually agreed to by all parties:
 - 1. Written reports are reference documents and are not part of the Contract Documents.
 - 2. Subsurface investigations are for the purpose of obtaining data for planning and design of the Project.
 - 3. Data concerning borings and test pits is intended to represent with reasonable accuracy conditions and material found in specific borings and test pits at the time the borings and test pits were made.
- C. It is expressly understood and agreed the Owner and Engineer assume no responsibility whatsoever in respect to the sufficiency or accuracy of the investigation thus made, the records thereof, or of the interpretations set forth therein, or made by the Owner in the Owner's use thereof; and there is no warranty or guarantee, either expressed or implied, that the conditions indicated by such investigations, or records thereof, are representative of those existing throughout such areas, or any part, or that unforeseen developments may not occur.
- D. The Owner's subsurface investigations and reporting are made available to Bidder or Contractor only on the basis of the understandings and agreement herein stated.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION - Not Used

END OF SECTION

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of existing facilities.
 - 2. Abandoning and removing utilities.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Submit to Engineer a copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.3 QUALITY ASSURANCE

- A. Existing Conditions: Determine the extent of work required and limitations before proceeding with Work.
- B. Conform to applicable local, state, and federal codes for environmental requirements in relation to disposal of debris.
 - 1. Burning at the Site for the disposal of refuse, debris, and waste materials resulting from demolition and site clearing operations shall not be permitted.
- C. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.
- D. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the Work and requirements of the General Provisions.
- E. If the existing material to be demolished and removed contains any hazardous materials which will require special handling upon removal, such as asbestos or lead, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or Specifications.
- B. Crushed Surfacing: As specified in Section 31 05 16-2.1, Aggregates for Earthwork or specified herein.
- C. Sand: As specified in Section 31 05 16-2.2, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. The Owner assumes no responsibility for the actual condition of the facilities to be demolished. The Contractor shall visit the site, inspect all facilities and be familiar with all existing conditions and utilities.
- B. Demolition drawings identify major equipment and structures to be demolished only. Auxiliary utilities such as water, air, chemicals, drainage, lubrication oil, hydraulic power fluid, electrical wiring, controls, and instrumentation are not necessarily shown shall be considered incidental to all demolition work.
- C. Identify waste and salvage areas for placing removed materials.

3.2 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 1-800-424-5555 not less than three working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
 - 3. Keep all active utilities intact and in continuous operations.

3.3 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.
- B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.
- C. Preservation and Trimming of Trees, Shrubs and Other Vegetation: As specified in Section 31 10 00-3.4.C, Site Clearing.
- D. Landscaped Areas: Protect existing landscaped areas as specified in Section 31 10 00-3.4.D, Site Clearing.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, guy wires, utility poles, and curbs.
- F. Repair and Replacement:
 - 1. Damaged items, including but not restricted to those noted above, shall be repaired, or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of Work of this contract.
 - 2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.4 DEMOLITIONS

- A. Areas which are to be excavated for the purpose of demolition shall be cleared and stripped in accordance with Section 31 10 00-3.6, Site Clearing.
- B. Carefully consider all bearing loads and capacities for placement of equipment and material on site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, consult with Engineer prior to the placement of such equipment or material.
- C. Demolition of Existing Structures:
 - 1. Excavate around existing structures as required to perform demolition operations and to plug associated existing pipelines where shown in the Drawing.

2. Provide shoring, bracing, and supports, as required, to ensure adjacent structures are not damaged and structural elements of existing structure are not overloaded during demolition activities.
 - a. Increase structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under any part of this Contract.
 - b. Remove all temporary protection when the Work is complete or when so authorized by the Engineer.
 3. Any floors that are to remain in place shall be completely cracked through to allow for drainage. Cracking shall be accomplished by dropping a demolition ball or by other methods approved by the Engineer.
 4. Remove and dispose of all exposed and/or protruding metalwork, piping, plumbing, and conduits resulting from demolition activities, and all woodwork, roofing, and electrical and mechanical equipment removed from demolished structures.
 - a. Reinforcing bars shall be cut flush with final wall elevations as shown in the Drawings.
 - b. No detached metalwork, excluding concrete reinforcing bars, shall be buried with the concrete and masonry rubble.
- D. Backfill at Demolished Structures:
1. For structures designated to be abandoned and/or demolished in place, concrete and/or masonry rubble and excavated soils resulting from demolition activities shall be used for backfill or placed in the bottoms of said structures only as directed by the Engineer.
 2. Concrete and masonry rubble used for backfilling shall be broken into pieces no larger than 12 inches on any one side.
 3. Materials resulting from abandonment/demolition activities approved for backfill shall be combined with imported filler sand to create a dense, compacted backfill.
 4. Backfilling or placement of the excavated material in the structures shall meet the following requirements.
 - a. Furnish, place and compact filler sand along with the concrete and masonry rubble so that all voids are filled and a dense, compacted backfill is obtained.
 - b. Filler sand shall be placed in horizontal layers completely filling all voids between pieces of rubble and not exceeding 12 inches in thickness.

- c. Each layer of filler sand shall be compacted to obtain at least 90 percent of maximum density as determined by ASTM Method D-698-78 (AASHTO T-99).
 - d. Water shall be furnished by the Contractor and added to each layer as required to maintain optimum moisture content.
 - e. The amount of filler sand used shall only be the amount needed to fill all voids created by placement of the concrete and asphalt rubble, as directed by the Engineer.
 - f. At locations where concrete and masonry rubble are used for backfill, they shall be placed such that a minimum of 3 feet of compacted non-rubble backfill material (crushed rock) exists between any rubble and finished grade. Protruding reinforcing bars shall be cut to lengths that allow granular backfill to be placed and compacted to required levels in and above the rubble.
- 5. Disposal of all materials not used for backfill shall be performed off-site and in compliance with applicable local, state, and federal codes and requirements.
 - 6. In areas where new construction will take place, no trace of these structures shall remain prior to placing of backfill.
- E. Backfilling within the footprint of new structures with rubble material resulting from demolition activities will not be allowed.
 - F. All existing improvements designated in the Drawings or specified to be removed, including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the demolition work.
 - G. Unless otherwise specified, any resulting voids shall be backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.

3.5 EXISTING WATER UTILITY PIPING ABANDONMENT

- A. As specified in Section 33 05 50, Existing Pipe Abandonment.

3.6 ELECTRICAL AND CONTROL SYSTEM DEMOLITION

- A. All electrical and control system demolition work shall at all times be conducted in a safe and proper manner to avoid injury from electrical shock to all personnel.
 - 1. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable.

2. At no time shall live electrical wiring or connections or those which can become energized be accessible to any persons without suitable protection or warning signs.

3.7 PERMANENT ABANDONMENT OF WELLS

- A. The Contractor shall be responsible for securing and paying any local, state, or federal fees for abandonment of the well.
- B. Abandonment of the well shall be performed by a licensed well constructor in the state in which the work is accomplished.
- C. All work shall be performed according to federal, state, and local standards for permanent well abandonment.

3.8 ASPHALTIC CONCRETE DEMOLITION

- A. Asphalt pavement shall be removed to the limits shown in the Drawings.
- B. The limits of the removal shall be saw cut.
- C. Asphalt pavement may not be used as rubble fill.

3.9 REMOVAL

- A. Remove debris, rock, excavated materials, rubble, abandoned piping, and extracted plant life resulting from abandonment and/or demolition activities from site.
- B. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- C. Removal: All material resulting from demolition, clearing, and grubbing, and trimming operations shall be removed from the Project Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.

3.10 GRADING

- A. All grading work shall be completed in accordance with Section 31 22 13, Rough Grading.

3.11 CLEANUP

- A. During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, debris, and dust and shall leave all areas affected by the work in a clean, condition, as may be subject to Engineer approval.

- B. Adjacent structures shall be cleaned of dust, dirt, and debris resulting from demolition.
- C. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

DIVISION 03 - CONCRETE

SECTION 03 00 00

CONCRETE – GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers general requirements and quality assurance provisions for all cast-in-place concrete.

1.2 DEFINITIONS

- A. Concrete Field Testing Technician: A person who has demonstrated knowledge and ability, and has credentials that are current with ACI, ICC, WABO, or other recognized certifying organizations, to perform and record the results of ASTM standard tests on freshly mixed concrete, and to make and cure test cylinders.
- B. Architectural Concrete: Concrete that is exposed as an interior or exterior surface in the completed structure and which requires special care in the selection of the concrete materials, forming, placing, and finishing to obtain the desired architectural appearance.
- C. Exposed to Public View: Situated so that it can be seen from a public location after completion of the building.
- D. High Early Strength Concrete: Concrete which, through the use of high early strength cement or admixtures, is capable of attaining specified strength at an earlier age than normal concrete.
- E. Lightweight Concrete: Concrete of substantially lower unit weight than concrete made using gravel or crushed stone aggregates.
- F. Mass Concrete: Any volume of concrete with dimensions large enough to require that measures be taken to cope with generation of heat from hydration of the cement and attendant volume change to minimize cracking.
- G. Normal Weight Concrete: Concrete having a unit weight of approximately 150 pounds per cubic foot made with gravel or crushed stone aggregates.
- H. Post-Tensioning: A method of prestressing reinforced concrete in which tendons are tensioned after the concrete has hardened.
- I. Prestressed Concrete: Concrete where internal stresses of such magnitude and distribution are introduced that the tensile stresses resulting from the service loads

are counteracted to a desired degree; in reinforced concrete, the prestressing is commonly introduced by tensioning tendons.

- J. Reference Standards: Standards of a technical society, organization, or association, including the codes of local or state authorities, which are referenced in the Contract Documents.
- K. Strength Test: The average of the compressive strengths of two cylinders made from the same sample of concrete and tested at 28 days or at test age designated for determination of f_c' .
- L. Submitted: Submitted to the Owner's Representative for review and acceptance.
- M. Work: The entire construction or separately identifiable parts thereof which are required to be furnished under the Contract Documents. Work is the result of performing services, furnishing labor, and furnishing and incorporating materials and equipment into the construction, all as required by the Contract Documents.

1.3 ABBREVIATIONS

Abbreviations for organizations issuing documents referred to in the specifications are listed below:

AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CRSI	Concrete Reinforcing Steel Institute
ICC	International Code Council
PTI	Post-Tensioning Institute
WABO	Washington Association of Building Officials
WSDOT	Washington State Department of Transportation

1.4 REFERENCE STANDARDS AND CITED PUBLICATIONS

Standards of ACI, ASTM, and AWS referred to herein are listed with serial designation and are part of the Specifications. Unless noted otherwise, reference standards shall be the latest edition.

A. ACI STANDARDS

ACI 117	Specifications for Tolerances for Concrete Construction and Materials
ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 347	Guide to Formwork for Concrete

B. ASTM STANDARDS

- A82 Specification for Steel Wire, Plain, for Concrete Reinforcement
- A184/A184M Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
- A185 Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
- A416/A416M Specification for Uncoated Seven-Wire, Stress-Relieved Steel Strand for Prestressed Concrete
- A421/A421M Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete
- A496 Specification for Steel Wire, Deformed, for Concrete Reinforcement
- A497 Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
- A615-A615M Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
- A706/A706M Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
- A722/A722M Specification for Uncoated High-Strength Steel Bar for Prestressing Concrete
- A767/A767M Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
- A775/A775M Specification for Epoxy-Coated Reinforcing Steel Bars
- A779/A779M Specification for Steel Strand, Seven-Wire, Uncoated, Compacted, Stress-Relieved for Prestressed Concrete
- A780 Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- A884/A884M Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement
- A996/A996M Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

- C31/C31M Practice for Making and Curing Concrete Test Specimens in the Field
- C33 Specification for Concrete Aggregates
- C39/C39M Test Method for Compressive Strength of Cylindrical Concrete Specimens
- C42/C42M Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
- C94/C94M Specification for Ready-Mixed Concrete
- C138/C138M Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- C143/C143M Test Method for Slump of Hydraulic Cement Concrete
- C150 Specification for Portland Cement
- C171 Specification for Sheet Materials for Curing Concrete
- C172 Practice for Sampling Freshly Mixed Concrete
- C173/C173M Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method
- C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory
- C231 Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C260 Specification for Air-Entraining Admixtures for Concrete
- C309 Specification for Liquid Membrane-Forming Compounds for Curing Concrete
- C330 Specification for Lightweight Aggregates for Structural Concrete
- C387 Specification for Packaged, Dry, Combined Materials for Mortar and Concrete
- C404 Specification for Aggregates for Masonry Grout
- C494/C494M Specification for Chemical Admixtures for Concrete
- C567 Test Method for Unit Weight of Structural Lightweight Concrete

- C595 Specification for Blended Hydraulic Cements
- C597 Test method for Pulse Velocity Through Concrete
- C618 Specification for Fly Ash and Raw or Clacined natural Pozzolan for Use as Mineral Admixture in Portland Cement Concrete
- C684 Test Method for Making, Accelerated Curing, and Testing of Concrete Compression Test Specimens
- C685/C685M Specification for Concrete Made by Volumetric Batching and Continuous Mixing
- C803/C803M Test Method for Penetration Resistance of Hardened Concrete
- C805 Test Method for Rebound Number of Hardened Concrete
- C873 Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds
- C881/C881M Specification for Epoxy-Resin-Base Bonding Systems for Concrete
- C900 Test Method for Pullout Strength of Hardened Concrete
- C928 Specification for Packaged, Dry, Rapid Hardening Cementitious Materials for Concrete Repairs
- C989 Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
- C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete
- C1059 Specification for Latex Agents for Bonding Fresh to Hardened Concrete
- C1064/C1064M Test Method for Temperature of Freshly Mixed Portland Cement Concrete
- C1074 Practice for Estimated Concrete Strength by the Maturity Method
- C1077 Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
- C1107 Specification for Packaged, Dry, Hydraulic Cement Grout
- D98 Specification for Calcium Chloride

D994 Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

D1751 Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types)

D1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

E11 Specification for Wire-Cloth Sieves for Testing Purposes

E329 Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

C. OTHER REFERENCED STANDARDS

AWS D-1.4 Structural Welding Code-Reinforcing Steel

AASHTO T260 Sampling and Testing for Total Chloride Ion in Concrete and Concrete Materials

Corps of Engineers Specification for Rubber Waterstops

CRD C513

Corps of Engineers Specification for Polyvinyl-Chloride Waterstops

CRD C572

PTI Specification for Unbonded Single-Strand Tendons

WSDOT Standard Specifications for Road, Bridge and Municipal Construction

D. CITED PUBLICATIONS

ACI 315 Details and Detailing of Concrete Reinforcement

ACI 318 Building Code Requirements for Reinforced Concrete

ACI CPI Technician Workbook for ACI Certification of Concreted Field Testing Technician – Grade I

ACI SP-15 Field Reference Manual

CRSI MSP-1 Manual of Standard Practice

1.5 SUBMITTALS

Testing agencies shall report results of concrete and concrete materials tests and inspections performed during the course of the work to the Owner's Representative, Contractor, and the Concrete Supplier. Strength test reports shall include location in the Work where the batch represented by test was deposited and the batch ticket number. Reports of strength tests shall include detailed information of storage and curing of specimens prior to testing. Final reports shall be provided within seven (7) days of test completion.

Concrete mix designs shall be provided for review in accordance with Section 03 31 00.

1.6 QUALITY ASSURANCE

- A. GENERAL: Concrete materials and operations shall be tested and inspected as work progresses. Failure to detect defective work or material shall not prevent rejection later when a defect is discovered.
- B. TESTING AGENCIES: Agencies that perform testing services on concrete materials shall meet the requirements of ASTM C1077. Testing agencies that perform testing services on reinforcing steel shall meet the requirements of ASTM E329. Testing agencies performing the testing shall be acceptable to Owner's Representative prior to performing any work. Tests of concrete shall be made by a Concrete Field Testing Technician.
- C. TESTING RESPONSIBILITIES OF CONTRACTOR
 - 1. Submit data on qualifications of proposed testing agency for acceptance. Use of testing services will not relieve agency for acceptance. Use of testing services will not relieve the Contractor of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
 - 2. Duties and Responsibilities. Unless otherwise specified in the Contract Documents, the Contractor shall assume the following duties and responsibilities:
 - a. Qualify proposed materials and establish mixture proportions.
 - b. Furnish any necessary labor to assist testing agency in obtaining and handling samples at the project site or at the source of materials.
 - c. Notify testing agency at least 24 hours in advance of operations to allow for completion of quality tests and for assignment of personnel.
 - d. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the job site for initial curing as required by ASTM C31.

- e. Submit data and test documentation on materials and mixture proportions.
- f. Submit quality control program of the concrete supplier and provide copies of all test reports.

D. TESTING RESPONSIBILITIES OF TESTING AGENCY

1. Unless otherwise specified in the Contract Documents, Testing Agency will provide the necessary services for the following:
 - a. Representatives of testing agency will inspect, sample, and test materials and production of concrete required by the Owner's Representative. When it appears that material furnished, or work performed by contractor fails to conform to Contract Documents, testing agency will immediately report such deficiency to the Owner's Representative, Contractor, and concrete supplier
 - b. Testing agency and its representatives are not authorized to revoke, alter, relax, enlarge, or release any requirement of the Contract Documents, nor to accept any portion of the Work.
 - c. Testing Agency shall report all test and inspection results to Owner's Representative, Contractor, and concrete supplier within seven days after tests and inspections are performed.
2. Testing Services. Review and check-test proposed materials for compliance with Contract Documents.
 - a. Review and check-test proposed design mixture as required by the Owner's Representative.
 - b. Obtain production samples of materials at plants or stockpiles during course of the Work and test for compliance with the Contract Documents.
 - c. Obtain composite samples in accordance with ASTM C172. Each sample shall be obtained from a different batch of concrete on a random basis, avoiding any selection of the test batch other than by a number selected at random before commencement of concrete placement.
 - d. Obtain at least one composite sample for each 50 cubic yards, or fraction thereof, of each design mixture of concrete placed in any one day. When the total quantity of concrete with a given design mixture is less than 50 cubic yards.
 - e. Conduct strength tests of concrete during construction in accordance with the following procedures:

- 1) Mold and cure four cylinders from each sample in accordance with ASTM C31. Record any deviations from the ASTM requirements in the test report.
- 2) Test cylinders in accordance with ASTM C39. Test one specimen at 7 days for information, and two specimens at 28 days for acceptance unless otherwise specified. The compressive strength test results for acceptance shall be the average of the compressive strengths from the two specimens tested at 28 days. If one specimen in a test shows evidence of improper sampling, molding, or testing, discard the specimen and consider the strength of the remaining cylinder to be the test result. If both specimens in a test show any defects, discard the entire test.
- 3) When accelerated testing of concrete is permitted as an alternative to standard testing, mold and cure two specimens from each composite sample in accordance with ASTM C684. Make at least one accelerated strength test from each composite and one standard 28-day compressive strength test for at least every other accelerated strength test in accordance with ASTM C31. Use these test results to maintain and update the correlation between accelerated and standard 28-day compressive strength tests.
 - a) Determine slump of each composite sample test and whenever consistency of concrete appears to vary, using ASTM C143.
 - b) Determine temperature of each composite sample in accordance with ASTM C1064.
 - c) Test concrete required to be air-entrained for air content by ASTM C231, ASTM C173, or ASTM C138. Determine air content of normal weight concrete for each composite sample. Additional tests shall be performed as necessary for control.
- 4) Other Testing Services As Needed. Testing agency shall perform the following testing services when necessary, at the Contractor's expense.
 - a) Additional testing and inspection required because of changes in materials or mixture proportions requested by the Contractor.
 - b) Additional testing of materials or concrete occasioned by failure to meet specification requirements.

E. TESTS ON HARDENED CONCRETE IN PLACE

1. General. Tests on hardened concrete will be performed by the testing agency when such tests are needed. Testing and core filling shall be at the Contractor's expense

when tests are performed to verify the strength of the structure when required by this specification.

2. Non-Destructive Tests. Use of the rebound hammer in accordance with ASTM C805, pulse velocity methods in accordance with ASTM C597, or other non-destructive devices may be permitted in evaluating the uniformity and relative concrete strength in place, or for selecting areas to be cored.
3. Core Tests.
 - a. Where required by the Owner's Representative, cores shall be obtained and tested in accordance with ASTM C42. If concrete in the structure will be dry under service conditions, the cores shall be air-dried (temperature 60 to 80°F, relative humidity less than 60 percent) for 7 days before testing and shall be tested dry. If concrete in the structure will be more than superficially wet under service conditions, the core shall be tested after moisture conditioning in accordance with ASTM C42.
 - b. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores shall impair the strength of the structure as little as possible. If, before testing, cores show evidence of having been damaged subsequent to or during removal from the structure, replacement cores shall be taken.
 - c. Core holes shall be filled with low slump concrete or mortar of a strength equal to or greater than the original concrete.

F. EVALUATION OF CONCRETE STRENGTH TESTS

1. Standard Molded and Cured Strength Specimens. Test results from standard molded and cured test cylinders shall be evaluated separately for each specified concrete design mixture. Evaluation will be valid only if tests have been conducted in accordance with procedures specified. For evaluation, each specified design mixture shall be represented by at least 5 tests.
2. Nondestructive Tests. Test results will be evaluated by the Owner's Representative and will be valid only if tests have been conducted by properly calibrated equipment in accordance with recognized standard procedures.
3. Core Tests. Core tests will be evaluated by the Owner's Representative and will be valid only if tests have been conducted in accordance with specified procedures.

G. ACCEPTANCE OF CONCRETE STRENGTH

1. Standard Molded and Cured Strength Specimens. The strength level of concrete will be considered satisfactory when the averages of all sets of three consecutive

compressive strength test results equal or exceed the specified compressive strength f_c' and no individual strength test result falls below the specified compressive strength f_c' by more than 500 psi. These criteria apply also when accelerated strength testing is specified unless another basis for acceptance is specified in the Contract Documents.

2. Nondestructive Tests. Nondestructive tests shall not be used as the sole basis for accepting or rejecting concrete, but may be used when permitted to evaluate concrete where standard molded and cured cylinders have yielded results not meeting the strength criteria.
3. Core Tests. Strength level of concrete in the area represented by core tests will be considered adequate when the average compressive strength of the cores are equal to at least 100 percent of specified compressive strength f_c' , and if no single core is less than 90 percent of the specified compressive strength f_c' .

H. FIELD ACCEPTANCE OF CONCRETE

1. Air Content. Concrete not within the limits of air entrainment indicated in Specification Section 03 31 00, shall not be used in the Work.
2. Slump. Concrete not within the slump limits of specification Section 03 31 00, at the point of placement shall not be used in the Work.
3. Temperature. Concrete not within temperature limits of Specification Section 03 31 00, shall not be used in the Work.

1.7 ACCEPTANCE OF STRUCTURE

- A. GENERAL: Completed concrete work shall conform to applicable requirements of this Specification and the Contract Documents.
 1. Concrete work that fails to meet one or more requirements of the Contract Documents but subsequently is repaired to bring the concrete into compliance may be accepted.
 2. Concrete work that fails to meet one or more requirements of the Contract Documents and cannot be brought into compliance will be rejected.
 3. Repair rejected concrete work by removing and replacing or by reinforcing with additional construction. To bring rejected work into compliance, use repair methods that will maintain specified strength and meet all applicable requirements for function, durability, dimensional tolerances, and appearance.

4. Submit for acceptance the proposed repair methods, materials, and modifications needed to assure that concrete work will meet requirements of Contract Documents.
 5. Contractor shall pay all costs to bring concrete work into compliance with requirements of the specification.
 6. Concrete members cast in the wrong location will be rejected.
- B. DIMENSIONAL TOLERANCES
1. Formed surfaces resulting in concrete outlines smaller than permitted by the tolerances of ACI 117, may be considered deficient in strength and subject to rejection.
 2. Formed surfaces resulting in concrete outlines larger than permitted by ACI 117 may be rejected. Excess materials will be subject to removal.
 3. Inaccurately formed concrete surfaces that exceed ACI 117 tolerances may be rejected.
 4. Finished slabs exceeding the tolerances in Specification Section 03 30 00, may be corrected provided strength or appearance are not adversely affected.
 5. Concrete with tolerances and defects exceeding the limitations of Specification Section 03 10 00, will be rejected.
- C. APPEARANCE
1. Concrete exposed to view with defects that adversely affect the appearance of the specified finish will be rejected.
 2. Concrete not exposed to view may be rejected for nonconforming appearance.
- D. STRENGTH OF STRUCTURE
1. Criteria for Determining Potential Strength Deficiency. Strength will be considered deficient and concrete will be rejected when the Work fails to comply with requirements which control the strength of the structure, including but not limited to the following conditions:
 - a. Concrete strength failing to comply with requirements of Acceptance of Concrete Strength.

- b. Reinforcing steel size, quantity, strength, position, or arrangement at variance with the requirements of Specification Section 03 20 00, or other Contract Document Requirements.
 - c. Concrete elements which differ from the required dimensions or location.
 - d. Curing not in accordance with Contract Documents.
 - e. Inadequate protection of concrete from extreme temperature and other environmental conditions during early stages of hardening and strength development.
 - f. Mechanical injury, construction fires, accidents, or premature removal of formwork resulting in deficient strength.
2. Action Required When Strength is Potentially Deficient. When strength of the structure is considered potentially deficient, the following actions may be required:
- a. Structural analysis or additional testing, or both.
 - b. Core tests.
 - c. If testing is inconclusive or impractical or if structural analysis does not confirm the safety of the structure, load tests may be required and their results evaluated in accordance with ACI 318.
 - d. Concrete work rejected by structural analysis or by results of a load test shall be reinforced with additional construction or replaced.
 - e. The Contractor shall document all repair work proposed to bring strength-deficient concrete work into compliance with Contract Documents and submit the documentation to Owner's Representative for acceptance.

E. DURABILITY

1. Criteria for Determining Potential Durability Deficiency. Durability of concrete will be considered deficient and the concrete work will be rejected when it fails to comply with the requirements which control durability of the structure, including but not limited to the following conditions:
- a. Strength failing to comply with Acceptance of Concrete Strength.
 - b. Materials for concrete not conforming to the requirements in Specification Section 03 31 00.

- c. Concrete not conforming with the air entrainment requirements in Contract Documents or the total air content limits of Specification Section 03 31 00.
 - d. Curing not in accordance with Contract Documents.
 - e. Inadequate protection of concrete from temperature and other environmental conditions during early stages of hardening and strength development.
2. Action Required When Durability is Potentially Deficient. When durability of the structure is considered to be deficient, the following actions will be taken by the Owner's Representative:
- a. Require that samples of the ingredient materials used in the concrete be obtained and tested.
 - b. Require that samples of hardened concrete be obtained from the structure by coring, sawing, or other acceptable means.
 - c. Require a laboratory evaluation of concrete and concrete materials to assess the ability of concrete to resist weathering action, chemical attack, abrasion, or other deterioration.
 - d. Concrete rejected for lack of durability shall be repaired or replaced.
 - e. The Contractor shall document repair work to bring concrete work into compliance with Contract Documents and submit the documentation to Owner's Representative for acceptance.

1.8 PROTECTION OF IN-PLACE CONCRETE

- A. **LOADING AND SUPPORT OF CONCRETE:** Construction loads shall not exceed the superimposed load which the structural member, with necessary supplemental support, is capable of carrying safely and without damage.
- B. **PROTECTION FROM MECHANICAL INJURY:** During the curing period, the Contractor shall protect concrete from damaging mechanical disturbances, including load stresses, shock, and harmful vibration. The Contractor shall protect concrete surfaces from damage by construction traffic, equipment, materials, rain or running water, and other adverse weather conditions.

END OF SECTION

SECTION 03 05 10

COLD WEATHER CONCRETING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers requirements for cold weather concreting and protection of concrete from freezing during the specified protection period.

1.2 DEFINITIONS

- A. Cold Weather: A period when for more than 3 successive days the average daily outdoor temperature drops below 40°F. The average daily temperature is the average of the highest and lowest temperature during the period from midnight to midnight. When temperatures above 50°F occur during more than half of any 24-hour duration, the period shall no longer be regarded as cold weather.
- B. Cold Weather Concreting: Operations concerning the placing, finishing, curing, and protection of concrete during cold weather.
- C. Protection Period: The required time during which the concrete is maintained at or above a specific temperature in order to prevent freezing of concrete or to ensure the necessary strength development for structural safety.

1.3 SUBMITTAL OF PROCEDURES

- A. The Contractor shall submit detailed, written procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during cold weather. In the submittal, include procedures to be implemented upon abrupt changes in weather conditions or equipment failures. Do not begin cold weather concreting until these procedures have been reviewed by the Owner's Representative.
- B. Minimum procedures for placement, curing and protection of the concrete shall follow the recommendations in ACI 306R, "Cold Weather Concreting." The details shall include, but not be limited to, the following:
 - 1. Procedures for protecting the subgrade from frost and the accumulation of ice or snow on reinforcement or forms prior to placement.
 - 2. Methods for temperature protection during placement.

3. Types of covering, insulation, housing, or heating to be provided.
4. Curing methods to be used during and following the protection period.
5. Use of strength-accelerating admixtures.
6. Methods of verification of in-place strength.
7. Procedures for measuring and recording concrete temperatures.
8. Procedures for preventing drying during dry, windy conditions.

PART 2 MATERIALS

2.1 SCHEDULING PROTECTION MATERIALS

All materials and equipment required for protection shall be available at the project site before cold weather concreting.

2.2 CONCRETE

Concrete for slabs and other flatwork exposed to cycles of freezing and thawing in a wet condition during the construction period shall be air entrained as specified in ACI 301, even though the concrete may not be exposed to freezing in service.

PART 3 EXECUTION

3.1 PREPARATION BEFORE CONCRETING

Remove all snow, ice, and frost from the surfaces, including reinforcement, against which the concrete is to be placed. Before beginning concrete placement, completely thaw the subgrade. Do not place concrete around embedded pipe penetrations unless such embedment is at a temperature above freezing.

3.2 CONCRETE TEMPERATURE

- A. Placement Temperature: The minimum temperature of concrete immediately after placement shall be as specified in Column 2 of Table 3.2A. The temperature of concrete as placed shall not exceed the values shown in Column 2 of Table 3.2A by more than 20°F.

TABLE 3.2A: CONCRETE TEMPERATURE		
(1)	(2)	(3)
Least dimension of section, inches.	Minimum temperature of concrete as placed and maintained during the protection period, °F.	Maximum gradual decrease in surface temperature during any 24-hour period after end of protection, °F.
Less than 12	55	50
12 to less than 36	50	40
36 to 72	45	30

- B. Protection Temperature: Unless otherwise specified, the minimum temperature of concrete during the protection period shall be as shown in Column 2 of Table 3.2A. Temperatures specified to be maintained during the protection period shall be those measured at the concrete surface, whether the surface is in contact with formwork, insulation, or air. Measure the temperature of concrete in each placement not less than twice daily at regular time intervals.
- C. Termination of Protection: The maximum decrease in temperature measured at the surface of the concrete in a 24-hour period shall not exceed the values shown in Column 3 of Table 3.2A. Do not exceed these limits until the surface temperature of the concrete is within 20°F of the ambient or surrounding temperatures. When the surface temperature of the concrete is within 20°F of the ambient or surrounding temperature, all protection may be removed.

3.3 CURING OF CONCRETE

Prevent concrete from drying during the required curing period. If water curing is used, terminate use at least 24 hours before any anticipated exposure of the concrete to freezing temperatures.

3.4 PROTECTION OF CONCRETE

- A. Combustion Heaters: Vent flue gases from combustion heating units to the outside of the enclosure.
- B. Overheating and Drying: Place and direct heaters and ducts to avoid areas of overheating or drying of the concrete surface.

- C. Maximum Air Temperature: During the protection period, do not expose the concrete surface to air having a temperature more than 20°F above the values shown in Column 2 of Table 3.2A, unless higher values are required by an accepted curing method.
- D. Protection against Freezing: Cure and protect concrete against damage from freezing for a minimum period of 3 days, unless otherwise specified. Maintain the surface temperature of the concrete during that period in accordance with Column 2 of Table 3.2A, unless otherwise specified. The protection period may be reduced to 2 days if use of one or more of the following to alter the concrete mixture is accepted:
 - 1. Type III Portland Cement meeting the requirements of ASTM C150.
 - 2. A strength-accelerating admixture meeting the requirements of ASTM C494.

During periods not defined as cold weather, but when freezing temperatures may occur, protect concrete surfaces against freezing for the first 24 hours after placing.

- A. Protection Deficiency: If the temperature requirements during the specified protection period are not met but the concrete was prevented from freezing, continue protection until twice the deficiency of protection in degree-hours is made up. Deficient degree-hours may be determined by multiplying the average deficiency in temperature by the number of hours the temperature was below the values shown in Column 2 of Table 3.2A.

END SECTION

SECTION 03 05 20

HOT WEATHER CONCRETING

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers requirements for placement of concrete during hot weather.

1.2 DEFINITION

Hot weather is defined as any combination of high ambient temperature, high concrete temperature, low relative humidity, wind velocity, and solar radiation, tending to impair the quality of fresh or hardened concrete, or otherwise resulting in detrimental concrete properties. During hot weather, any or all of the methods specified herein for temperature control of concrete shall be used as required to maintain the concrete temperature below the limits specified.

1.3 PRODUCT DELIVERY, HANDLING, AND STORAGE

- A. Aggregate piles, cement bins and batch plant bins shall be shaded from the direct rays of the sun, when possible.
- B. Aggregate piles may be cooled by wetting and evaporation. Aggregate wetting shall be performed in such a manner that is accounted for in the total water added to the mix.

1.4 GENERAL PRACTICES AND MEASURES

The Contractor shall be responsible for practices and procedures to ensure that concrete quality is not adversely affected by hot weather. Practices and procedures and combinations thereof shall be as described in ACI 305R, Hot Weather Concreting, and may include the following:

- A. Retarding admixtures
- B. Cooling of aggregates and/or mix water
- C. Reduction in time of discharge and expedited placement.
- D. Shading and/or cooling of the placement site.
- E. Use of cements with reduced heat of hydration.
- F. Reduction of cement content.

- G. Placement at night.
- H. Cooling coils in the element being constructed.
- I. Use of ice as part of the mix water.

1.5 SUBMITTALS

- A. The Contractor shall submit detailed, written procedures for the production, transportation, protection, curing, and temperature monitoring of concrete during hot weather. In the submittal, include procedures to be implemented upon abrupt changes in weather conditions or equipment failures. Do not begin hot weather concreting until these procedures have been reviewed by the Owner’s Representative.
- B. Modifications in mix design shall require the approval. No embedding cooling devices may be placed in concrete elements without the approval of the Owner’s Representative.

PART 2 MATERIALS

2.1 CURING COMPOUNDS

Curing compounds, when their use is permitted for hot weather concreting, shall conform to ASTM C309, Type 2 except as follows: Water loss, when tested in accordance with ASTM C156, shall not exceed 0.39 kg/m² in 72 hours.

PART 3: CONSTRUCTION

3.1 CONCRETE TEMPERATURE

The temperature of concrete as delivered at the time and location of placement shall not exceed 100°F under any conditions. The temperature of concrete as delivered at the time and location of placement under the following combined ambient conditions, except concrete that will be deposited within wall or column forms shall not exceed the following temperatures:

Relative Humidity Less Than %	Ambient Temperature Greater than °F	Maximum Concrete Temperature °F
80	90	100
70	90	95
60	90	90
50	90	85
40	90	80
30	80	75

3.2 DELIVERY

Concrete shall be placed in the Construction within 60 minutes after the completion of mixing.

3.3 FINISHING

Fog spray shall be used during finishing operations whenever necessary to avoid surface plastic-shrinkage cracking. Fog spray shall also be used after finishing and before the specified curing is commenced to avoid surface plastic-shrinkage cracking.

3.4 PROTECTION AND CURING

- A. Wet cure methods shall be used. Forms shall be kept covered and continuously moist. Once forms are loosened, and during form removal, concrete surfaces shall be protected from drying and shall be kept continuously wet by fog spraying or other approved means.
- B. Curing compounds may be used to augment wet cure methods but shall not be used in lieu of a wet cure.

END SECTION

SECTION 03 11 00

CONCRETE FORMWORK

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers design, construction and treatment of formwork to confine and shape concrete to the required dimensions.

1.2 MATERIALS HANDLING

All materials and equipment shall be shipped, stored, handled and installed in such a manner as not to degrade quality, serviceability or appearance.

PART 2 PRODUCTS

2.1 MATERIALS

A. FORM FACING MATERIALS: Materials for form faces in contact with concrete shall meet the following requirements, unless otherwise specified in the Contract Documents.

1. For Rough Form Finish. No form facing material is specified.

B. FORMWORK RELEASE AGENT: Use commercially manufactured form release agent that will prevent formwork absorption of moisture, prevent bond with concrete, not stain the concrete surfaces, and not leave residual matter on surface of concrete or adversely affect proper bonding or subsequent application of other material applied to concrete surface.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. Locate and detail formed joints to the following requirements:

1. Provide keyways where indicated on Contract Drawings. Where longitudinal keyways are indicated on the Contract Drawings, make them a minimum of 1½-inch deep in joints in walls and between walls and slabs or footings.

2. Provide control joints where indicated on the Contract Documents. The location of control joints other than those indicated on the Contract Documents shall be submitted for acceptance.

B. For smooth form finish, arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to a practical minimum. Support facing

material with studs or other backing capable of preventing excessive deflection within the tolerances.

2.3 FABRICATION AND MANUFACTURE

- A. Formwork shall be tight to prevent loss of mortar from concrete. Provide watertight formwork when architectural concrete is specified.
- B. Place ¾-inch-minimum chamfer strips in the corners of formwork to produce beveled edges on permanently exposed surfaces and the edges of formed joints.
- C. Provide temporary openings at the base of the column and wall formwork and at other points where necessary to facilitate cleaning and inspection. Clean and inspect immediately before concrete is placed.
- D. Fabricate embedded form ties so ends or end fasteners can be removed with minimum spalling at the faces of concrete.

PART 3 EXECUTION

3.1 CONSTRUCTION AND ERECTION OF FORMWORK

- A. At construction joints, lap contact surface of the form sheathing for flush surfaces exposed to view over the hardened concrete in the previous placement by not more than 1 inch.
- B. Ensure formwork is held firmly against hardened concrete to prevent offsets or loss of mortar at construction joints and to maintain a true surface.
- C. Unless otherwise specified in Contract Documents, construct formwork so concrete surfaces will conform to tolerance limits of ACI 117. The class of surface as given in ACI 117 shall be as follows:
 - 1. Footings: Class C
 - 2. Stem Walls & Slab Edges: Class A
- D. Provide positive means of adjustment (wedges or jacks) of shores and struts. Do not make adjustments in the formwork after concrete has taken its initial set. Brace formwork securely against lateral deflection.
- E. Fasten form wedges in place after final adjustment of forms and prior to concrete placement.
- F. Anchor formwork to shores, supporting surfaces, or members to prevent upward or lateral movement of the formwork system during concrete placement.

- G. The Contractor shall form for and leave all openings in the concrete work where required for the installation of his own work and/or for the work of others. He shall carefully examine all drawings for the need of such openings, and in failing to provide openings as shown on the drawings, he shall cut them at his own expense. Except as otherwise noted or specified, all such openings shall be filled with concrete, after the work to be installed therein has been completed.
- H. Provide runways for moving equipment and support runways directly on the formwork or structural member without resting on the reinforcing steel.
- I. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for support of adjoining work prior to concrete placement.
- J. Position and support expansion joint material, and other embedded items to prevent displacement. Fill voids in sleeves, inserts, and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
- K. Clean surfaces of formwork and embedded materials of mortar, grout, and foreign material before concrete is placed.
- L. Cover surfaces of formwork with acceptable formwork release agent. Apply form release agent before placing reinforcing steel and concrete. A field-applied formwork release agent or sealer of an acceptable type or an acceptable factory-applied, non-absorptive liner may be used. Do not allow formwork release agent to puddle in the forms. Do not allow formwork release agent to contact reinforcing steel or hardened concrete against which fresh concrete is to be placed.

3.2 REMOVAL OF FORMWORK

- A. When finishing is required, remove formwork as soon as removal operations will not damage concrete.
- B. Remove top forms on sloping surfaces of concrete as soon as removal will not allow concrete to sag. Perform needed repairs or treatment required at once and follow immediately with specified curing.
- C. Loosen formwork for wall openings when this can be accomplished without causing damage to concrete.
- D. Do not allow removal of formwork for columns, walls, sides of beams, and other parts not supporting the weight of the concrete to damage the concrete. Perform needed repair and treatment required on vertical surfaces at once and follow immediately with specified curing.
- E. FORM REMOVAL SAFETY

1. All responsibility involved in the removal of forms, shores, and bracing shall rest with the Contractor, and he shall be solely responsible for accidents to persons and property of any nature.
- F. All parts of removed forms, reserved for reuse shall be inspected, cleaned and repair. Any part or panel which has been dented, deformed or otherwise rendered unfit for reuse shall be discarded.

3.3 FIELD QUALITY CONTROL

- A. Establish and maintain controls and benchmarks in an undisturbed condition until final completion and acceptance of the project.
- B. Variations from plumb and designated building lines shall not exceed the tolerances specified in ACI 117.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. GENERAL

1. The Contractor shall notify all trades when construction is ready for the setting of anchor bolts, inserts, sleeves, and other built-in equipment, in order that such material shall be set at the proper time. Before placing concrete, care shall be taken to determine that all items to be embedded in concrete are accurately located, firmly secured in place and protected from damage or displacement until securely held by the concrete.
 2. All items shall be thoroughly cleaned, free from rust, scale, dirt, grease or other coating. Any wood used for removable keys shall be thoroughly dampened before concrete is placed against the wood. The Contractor shall be responsible for any displacement of the items caused by his workers.
- B. Electrical conduit may be embedded in concrete, provided the following conditions are met. Conduit runs which cannot satisfy these conditions shall be done at the Contractor's expense.
1. Outside diameter of conduit shall not exceed $\frac{1}{3}$ of the concrete thickness.
 2. Conduit shall not be placed closer than 3 diameters on center.
 3. Conduit shall not be embedded in structural concrete slabs less than 4 inches thick.
 4. Only 2 conduits may cross at any point. The sum of the outside diameter of the crossing conduits shall not exceed $\frac{1}{3}$ of the concrete thickness.

5. A 1½-inch-minimum concrete cover shall be provided for conduits in structural concrete slabs.
6. Conduit shall not be located between bottom of reinforcing steel and bottom of concrete slab.
7. Conduit is generally not permitted in beams or girders.
8. Aluminum conduit shall not be embedded in concrete.
9. Reinforcing steel and/or post-tensioning ducts shall not be repositioned to clear conduit. Adjust conduit positions to clear reinforcement.

END OF SECTION

SECTION 03 15 00

CONCRETE ACCESSORIES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers concrete anchors and miscellaneous embedded items.

1.2 SUBMITTALS

Catalog data for all items covered by this section to be incorporated in the Work.

PART 2 MATERIALS

2.1 ANCHOR BOLTS

Anchor bolts shall be either drilled anchors or cast-in-place as shown on the Plans.

- A. For equipment anchorage, drilled anchors shall either be epoxy adhesive type or expansion type, torque-controlled, 316 stainless steel, Hilti, or approved equal. Hole diameter shall be in accordance with manufacturer's instructions. Epoxy adhesive anchors shall be Hilti HIT-HY 200, or approved equal, and shall have ICC-ES report approval for application in regions of high seismicity. Expansion anchors shall be Hilti Kwik Bolt-TZ, or approved equal, and shall have ICC-ES report approval for application in regions of high seismicity.
- B. All anchors shall be male-type projecting anchors, unless female-type anchors are specifically called out otherwise. Provide minimum embedment depths shown on the Contract Drawings, but in no case less than product minimums for the size called out. Connected work shall not bear on threads.
- C. Cast-in-place anchor bolts for attachment of wood nailers shall be galvanized ASTM A307, unless otherwise indicated on the Drawings.

2.2 REGLETS

Reglets shall be as manufactured by Progress Unlimited, Inc., Heckman, or equal. Reglet shall be of rigid PVC plastic and accurately placed and free from grout to assure an acceptable channel to receive gasket.

2.3 PREFORMED JOINT FILLER

Preformed joint filler shall be asphalt-impregnated expansion filler conforming to ASTM D1751.

2.4 BACKER ROD

Backer rod for joint sealant shall be closed-cell polyethylene foam, circular profile, furnished in sizes greater in diameter than the joint thickness.

2.5 JOINT SEALANT

A. ALL EXPOSURES: Two-part polyurethane sealant, Daraseal U Non-Sag by A.C. Horn, Inc., Sikaflex-2C by Sika Corporation or equal. A primer shall be applied to the concrete prior to the sealant application. Backer rod shall be used.

PART 3 EXECUTION

3.1 ANCHOR BOLTS

A. All drilled anchors shall be tensioned using torque wrenches in accordance with Manufacturer's instructions.

END OF SECTION

SECTION 03 15 13

WATERSTOPS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers minimum requirements for waterstops.

1.2 CONTRACTOR SUBMITTALS

- A. **SAMPLES:** The Contractor shall submit samples of all the materials and waterstop sections he or she proposes to use on the work. All waterstop sections must conform to the shapes and sizes specified. The samples shall be clearly marked to show the manufacturer's name and product identification. The samples shall be submitted along with the manufacturer's test data and all laboratory test data required to show compliance with cited reference standards and requirements specified herein.
- B. **CERTIFICATES:** The Contractor shall provide certification from a recognized independent testing laboratory attesting that the material submitted will meet or exceed each and all the physical and chemical characteristics specified herein and in the references cited herein.

1.3 QUALITY ASSURANCE

- A. **WATERSTOP INSPECTION:** All waterstop placements shall be inspected before concrete may be placed on either side of a waterstopped joint.
- B. All field joints in waterstops shall be inspected for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects which would reduce the potential resistance of the material to water pressure at any point. All defective joints shall be replaced with material which will pass said inspection, and all faulty material shall be removed from the site and disposed of by the Contractor.
- C. The following defects shall be grounds for rejection:
 - 1. Offsets at joints greater than $\frac{1}{32}$ inch (0.8 mm), or 15% of material thickness at any point, whichever is less.
 - 2. Exterior crack at welded joint in outer surface, due to incomplete bond, which is deeper than $\frac{1}{32}$ inch (0.8 mm), or 15% of material thickness at any point, whichever is less.

3. Any combination of offset or exterior crack which will result in a new reduction in the cross-section of the waterstop excess of $\frac{1}{32}$ inch (0.8 mm), or 15% of material thickness at any point, whichever is less.
4. Misalignment of joint which results in a longitudinal misalignment of the waterstop in excess of $\frac{1}{2}$ inch in 10 feet (12 mm in 3 m).
5. Porosity in the welded joint as evidenced by visual inspection.
6. Bubbles or inadequate bonding which can be detected with a pen-knife test. (If while prodding the entire joint on each with the point of a pen knife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
7. Nail holes in the middle $\frac{2}{3}$ of the waterstop material.
8. Dirt, oil, grease, paint, concrete laitance, or other foreign material on the waterstop.

1.4 STORAGE AND HANDLING

- A. All waterstops shall be stored out of direct sunlight so as to permit free circulation of air around the waterstop material. In the event any PVC waterstop is installed in the concrete on one side of a joint and will remain unembedded in concrete on the opposite side of the joint for more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from the direct rays of the sun during the entire exposure and until the waterstop is embedded in the concrete on both sides of the joint.
- B. Hydrophilic waterstop material shall be kept in dry storage prior to use.

PART 2 MATERIALS

2.1 WATERSTOPS

Waterstops shall be of the following types as permitted by the specifications and shown on the Contract Drawings.

- A. PVC WATERSTOPS: Except where other waterstop types are shown on the Plans, all waterstops shall be Greenstreak 732 or approved equal, centerbulb type extruded virgin polyvinyl chloride, minimum tensile strength 2,000 psi, ultimate elongation 350%, with properties as follows.
 1. Six-inch-wide, with $\frac{7}{8}$ " bulb outside diameter, $\frac{5}{8}$ " rib corrugations both sides of bulb with thickness no less than $\frac{3}{8}$ inch. Heat-sealed joints.

B. CHEMICAL-RESISTANT THERMOPLASTIC WATERSTOP: Chemical-resistant waterstop shall be thermoplastic elastomeric rubber (TPER) as manufactured by WESTEC, St. Louis, MO, or approved alternate with the following properties:

- 1. Tensile strength 1,800 psi ASTM D412
- 2. Ultimate elongation 450% ASTM D412
- 3. 100% modules 1,000 psi ASTM D412
- 4. Shore & hardness 85±5 ASTM D2240

C. RETROFIT WATERSTOP: Retrofit waterstop shall be either PVC or chemical-resistant thermoplastic type unless stipulated on the Drawings. Waterstop shall be a 'T' profile, with the stem projecting into the new concrete side of the joint. The stem shall be ribbed and project at least 2 inches into the new concrete. Provide a centerbulb at the base of the 'T'.

The waterstop shall be provided with stainless steel batten bars and concrete screws for securing to existing concrete. The waterstop shall be grooved to match the battens.

D. HYDROPHILIC WATERSTOP: Hydrophilic waterstops shall all be one type, either bentonite or modified chloroprene rubber.

1. Bentonite Waterstop

- a. Waterstops shall be 1"x¾" minimum, strip type, sodium bentonite base material.
- b. The material shall meet or exceed;

Item	Standard	Criteria
Butyl Rubber – Hydrocarbon (% by weight)	ASTM D297	25%
Bentonite	SS-S-210A	75%
Volatile Matter	ASTM D-6	Below 1%
Specific Gravity at 77°F	ASTM D71	1.57
Penetration	ASTM D217	
	150 GTL	58
	300 GTL	85
Flash Point	ASTM D-93	365

- c. *Manufacturer:* Greenstreak "Swellstop" or approved alternate.

2. Modified Chloroprene Rubber Waterstop

- a. Waterstop shall be nominal 1"x1" outside dimension, hollow core profile.

b. The material shall meet or exceed:

Property	Unit	Chloroprene Rubber
Specific gravity		1.41
Hardness	(JIS-A)	51
Tensile strength	kgf/cm ² (psi)	125 (1774)
Elongation	%	435

c. *Manufacturer:* Greenstreak “Hydrotite” or approved alternate.

PART 3 CONSTRUCTION

3.1 INSTALLATION OF WATERSTOPS

- A. All waterstops shall be fully continuous for the extent of the joint. Splices necessary to provide such continuity shall be accomplished in conformance to printed instructions of manufacturer of the waterstop.
- B. The Contractor shall take suitable precautions and means to support and protect the waterstops during the progress of the work and shall repair or replace at his own expense any waterstop damage during the progress of the work.
- C. All waterstops shall be stored so as to permit free circulation of air around the waterstop material. In the event any waterstop is installed in the concrete on one side of a joint and will remain unembedded in concrete on the opposite side of the joint form more than 2 days, suitable precautions shall be taken to shade and protect the exposed waterstop from the direct rays of the sun during the entire exposure and until the waterstop is embedded in the concrete on both sides of the joint.
- D. The waterstop shall be correctly positioned in the forms so that the center of the waterstop is centered on the joint unless otherwise detailed on the Contract Drawings.
- E. In cases where preformed expansion joint material is used in conjunction with the waterstop, allowance shall be made for equal waterstop embedment on each side in the concrete.
- F. 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.

- G. Horizontal 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.
- H. 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.
- I. 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.

3.2 SPLICES IN ELASTOMERIC WATERSTOPS

- A. Splices in the continuity or at intersections around the waterstops shall be performed by heat-sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations. It is essential that:
 - 1. The material not be damaged by heat sealing.
 - 2. The splices have a tensile strength of not less than 75 percent of the unspliced materials tensile strength.
 - 3. The continuity of the waterstop ribs and centerbulbs shall be maintained.
- B. Butt joints of the ends of two identical waterstop sections may be made while the material is in place in the forms.
- C. All joints in waterstop involving more than two ends jointed together, and all joints which involve an angle cut, alignment change, or the joining of two dissimilar waterstop sections shall be fabricated by the Contractor prior to placement in the forms, allowing not less than 18-inch-long (450 mm) strips of waterstop material beyond the joint. Upon being inspected and approved, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 18-inch (450 mm) strips shall be butt-welded to the straight-run portions of waterstop in place in the forms.
- D. All waterstops shall be properly spliced, and joints shall be checked for strength and pinholes after splicing.

3.3 HANDLING OF HYDROPHILIC WATERSTOP

- A. Confine waterstop within the concrete joint, with a minimum 2-inch concrete cover to the exterior joint surface, unless otherwise indicated.
- B. Exposed waterstop must be kept dry before concrete pour. If swelling occurs prior to confinement, replace with new material.

- C. Nail waterstop to hardened concrete to hold securely in place during concrete placement of second pour.

3.4 SPLICES FOR HYDROPHILIC WATERSTOP

- A. BENTONITE TYPE: Butt ends of waterstop together. Do not overlap.
- B. MODIFIED CHLOROPRENE RUBBER: Butt ends of waterstop together and glue with Manufacturer's recommended adhesive.

3.5 CONCRETE PLACEMENT AROUND WATERSTOPS

Special care shall be used in placing concrete around waterstops by careful working, routing, and vibrating to ensure that all air and rock pockets have been eliminated.

3.6 INSTALLATION OF RETROFIT WATERSTOP

Existing concrete shall be cleaned and roughened in areas to receive retrofit waterstop. The waterstop shall be bonded to the prepared concrete with epoxy adhesive and mechanically anchored with stainless steel battens and concrete screws or anchors in accordance with Manufacturer's installation instructions.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers materials, fabrication, placement and tolerances of reinforcement and reinforcement accessories.

1.2 SUBMITTALS

A. Submit the following project data unless otherwise specified:

1. Placing Drawings. Submit placing shop drawings showing bar size, fabrication dimensions and locations for placement of reinforcement and reinforcement supports. Sufficient rebar reinforcing details to permit installation and inspection without reference to contract drawings. Rebar details in accordance with ACI SP-66. Drawings shall include size, spacing, dimensions, configurations and locations of all core drilled holes, pipe sleeves and embedded items. Provide clear indication of the relationship of the core drilled, pipe sleeves and embedded items to the reinforcing steel.
2. Splices: Submit a list and request to use splices not indicated in Contract Documents.
3. Mechanical Connections. Submit request for the use of mechanical connections not shown on the Project Drawings.

B. Submit the following data when alternatives are proposed:

1. Reinforcement Relocation. Submit request to relocate any reinforcement that exceeds placement tolerances.

1.3 MATERIALS DELIVERY, STORAGE AND HANDLING

A. Prevent bending, coating with earth, oil or other material, or otherwise damaging the reinforcement.

PART 2 PRODUCTS

2.1 MATERIALS

- A. REINFORCING BARS: Bars used as reinforcement shall be deformed except welded wire fabric, which may be plain unless otherwise designated on the Contract Drawings. Reinforcement shall be grade 60 unless otherwise indicated on the Contract Drawings and shall conform to one of the following:
1. ASTM A615
 2. ASTM A706
- B. BAR MATS: Use bar mats of the clipped type conforming to ASTM A184 assembled from one of the following combinations:
1. Bars conforming to ASTM A615 or ASTM A706.
- C. WIRE: Use plain or deformed wire as indicated on the Contract Drawings.
1. Plain wire shall conform to ASTM A82.
 2. Deformed wire size D4 and larger shall conform to ASTM A496.
 3. For wire with a specified yield strength f_y exceeding 60,000 psi, f_y shall correspond to a strain of 0.35 percent.
- D. WELDED WIRE FABRIC
1. Plain Wire Fabric. ASTM A185, with welded intersections spaced not farther apart than 12 inches in the direction of principal reinforcement.
 2. Deformed Wire Fabric. ASTM A497, with welded intersections spaced not farther than 16 inches in the direction of principal reinforcement.
 3. For welded wire fabric with a specified yield strength f_y exceeding 60,000 psi, f_y shall correspond to a strain of 0.35 percent.
- E. WIRE REINFORCEMENT SUPPORTS: Unless otherwise specified or permitted, use wire reinforcement supports complying with Class 1, maximum protection, or Class 2, moderate protection as indicated in the CRSI *Manual of Standard Practice*, Chapter 3, Bar Supports.
- F. ALL-PLASTIC BAR SUPPORTS: All-plastic bar supports may be used for horizontal and vertical reinforcing steel. They may have a snap-on action or other method of attachment. All-plastic supports shall be non-porous and chemically inert in concrete. All-plastic bar supports shall have rounded seatings so as not to punch holes in the

formwork and shall not deform under load when subjected to normal temperatures encountered in use, nor shall they shatter or severely crack under impact loadings when used in cold weather.

All-plastic bar supports shall have at least 25% of their gross plane area perforated, and shall not be placed closer than 12 inches apart along a bar.

- G. TIE WIRE: No. 16 American Wire Gauge or heavier, black annealed per ASTM A82.

2.2 FABRICATION

- A. REINFORCEMENT: Bend all reinforcement cold unless heating is specifically authorized in the Contract Documents. Fabricate reinforcement in accordance with fabricating tolerances of ACI 117.

- B. WELDING

- 1. When welding of reinforcement is required or permitted, make all welds in conformance with AWS D1.4. Do not weld crossing bars (tack welding) for assembly of reinforcement, supports, or embedded items.

PART 3 EXECUTION

3.1 PREPARATION

When concrete is placed, all reinforcement shall be free of materials deleterious to bond. Reinforcement with rust, mill scale, or a combination of both will be considered satisfactory, provided the minimum nominal dimensions, nominal weight and the minimum average height of deformations of a hand-wire-brushed test specimen are not less than the applicable ASTM specification requirements.

3.2 PLACEMENT

- A. TOLERANCES: Place, support, and fasten reinforcement as shown on the Contract Drawings. Do not exceed the placing tolerances specified in ACI 117 before concrete is placed. Placing tolerances shall not reduce cover requirements except as specified in ACI 117.

- B. REINFORCEMENT RELOCATION: When necessary to move reinforcement beyond the specified placing tolerances to avoid interference with other reinforcement, conduits or embedded items, submit the resulting arrangement of reinforcement for acceptance.

- C. CONCRETE COVER: Minimum concrete cover for reinforcement, unless otherwise indicated in the Contract Drawings, shall be as indicated below:

	Minimum Cover (inches)
Slabs & Joists	
Top & bottom bars for dry conditions	
#11 bars and smaller	$\frac{3}{4}$
#14 and #18 bars	1½
Formed concrete surfaces exposed to earth, water or weather, and over or in contact with sewage and for bottoms bearing on work mat, or slabs supporting earth cover.	
#5 bars and smaller	1½
#6 through #18 bars	2
Beams & Columns, formed	
For dry conditions	
Stirrups, spirals and ties	1½
Principal reinforcement	2
Walls	
For dry conditions	
#11 bars and smaller	$\frac{3}{4}$
#14 and #18 bars	1½
Formed concrete surfaces exposed to earth, water, sewage, weather, or in contact with ground	2
Footings and Slabs	
At formed surfaces and bottoms bearing on concrete work mat	2
At unformed surfaces and bottoms in contact with earth (Except slabs on grade)	3
Top of footings	same as slabs

Tolerances on minimum concrete cover shall meet the requirements of ACI 117.

- D. REINFORCEMENT SUPPORTS: Size and spacing of reinforcement supports shall conform to the CRSI *Manual of Standard Practice*. Reinforcement shown on the Contract Drawings shall not be relocated to serve as bolsters for other bars. The Contractor shall provide additional bars if necessary to support the reinforcement shown on the Contract Drawings.

Horizontal bars in slabs and beams shall be supported at intervals not greater than 48 inches.

Wall and column reinforcement shall be laterally supported by side form spacers or other means at intervals not greater than 48 inches horizontally or vertically in the case of walls, and not greater than 48 inches vertically and at not less than 90-degree

intervals in the case of columns.

Unless otherwise approved, use the following reinforcement supports:

1. Place reinforcement supported from the ground or mud on precast concrete reinforcement supports.
 2. Place non-coated reinforcement supported from formwork on reinforcement supports made of concrete, metal or plastic.
 3. Place zinc-coated (galvanized) reinforcement supported from formwork on wire reinforcement supports, which are galvanized, coated with dielectric material, or made of dielectric material.
 4. Reinforcement and embedded steel items used with zinc-coated (galvanized) reinforcement shall be zinc-coated (galvanized) or coated with non-metal materials.
 5. Place epoxy-coated reinforcement supported from formwork on coated wire reinforcement supports, or on reinforcement supports made of dielectric material. Coatings or materials shall be compatible with concrete.
 6. When precast reinforcement supports with embedded tie wires or dowels are used with epoxy-coated reinforcement, wires, or dowels shall be coated with dielectric material.
 7. Reinforcement used as supports with epoxy-coated reinforcement shall be epoxy-coated.
 8. In walls reinforced with epoxy-coated reinforcement, spreader bars shall be epoxy-coated. Proprietary combination bar clips and spreaders used in walls with epoxy-coated reinforcement shall be made of corrosion-resistant material or coated with dielectric material.
 9. Fasten epoxy-coated reinforcement with tie wires coated with epoxy or other polymer.
- E. WELDED WIRE FABRIC: For slabs on grade, extend welded wire fabric to within 2 inches of the concrete edge. Lap edges and ends of fabric sheets a minimum of one-mesh spacing. Welded wire fabric may extend through contraction joints only where permitted. Support welded wire fabric during placing of concrete to assure required positioning in the slab. Do not place welded wire fabric on grade and subsequently raise into position in concrete.
- F. COLUMN DOWELS: Furnish and use templates for placement of column dowels unless otherwise permitted.

G. Make splices as indicated on the Contract Drawings unless otherwise approved. Mechanical connections for reinforcement not shown on the Contract Drawings may be used when approved. Reinforcement coating shall be removed in the area of the mechanical connection if so required by the connection manufacturer. After installing mechanical connections on zinc-coated (galvanized) or epoxy-coated reinforcement, repair coating damage and areas of removed coating in accordance with 2.1.B.1 and 2.1.B.2. Coat exposed parts of mechanical connections used on coated bars with the same material used for repair of coating damage.

H. FIELD BENDING OR STRAIGHTENING:

Reinforcing bar sizes No. 3 through No. 5 may be bent cold the first time provided reinforcing bar temperature is above 32°F. For other bar sizes, preheat reinforcing bars before bending.

1. Preheating. Apply heat by any method which does not harm the reinforcing bar material or cause damage to the concrete. Preheat a length of reinforcing bar equal to at least 5 bar diameters in each direction from the center of the bend, but do not extend preheating below the surface of the concrete. Do not allow the temperature of the reinforcing bar at the concrete interface to exceed 500°F.

The preheat temperature of the reinforcing bar shall be 1100 to 1200°F.

Maintain the preheat temperature until bending or straightening is complete.

Measure the preheat temperature by temperature measurement crayons, contact pyrometer, or other acceptable method.

Do not artificially cool heated reinforcing bars until the temperature of the bar is less than 600°F.

Bending or straightening reinforcement partially embedded in concrete is not permitted

2. Bend Diameters. Minimum inside bend diameters shall conform to the requirements of the table below unless otherwise permitted. In addition, beginning of the bend shall not be closer to the concrete surface than the minimum diameter of bend.

<u>Bar Size</u>	<u>Minimum Inside Bend Diameter</u>
#3 through #8	6 bar diameters
#9, #10 and #11	8 bar diameters
#14 and #18	10 bar diameters

3. Repair of Bar Coatings. After field bending or straightening zinc-coated (galvanized) or epoxy-coated reinforcing bars, repair coating damage with 2.01.B1 or 2.01.B2.
- I. FIELD CUTTING OF REINFORCEMENT: Reinforcement shall not be cut in the field except when specifically permitted.
 1. When zinc-coated (galvanized) reinforcing bars are cut in the field, coat the ends of the bars with a zinc-rich formulation used in accordance with the manufacturer's recommendations, and repair any coating damage in accordance with 2.1.B.1.
 2. When epoxy-coated reinforcing bars are cut in the field, coat the ends of the bars with the same material used for repair of coating damage, and repair any coating damage in accordance with 2.1.B.2.
 - J. REINFORCEMENT THROUGH EXPANSION JOINT: Do not continue reinforcement or other embedded metal items bonded to concrete through expansion joints. Dowels bonded on only one side of a joint and water stops may extend through the joint.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers the production of cast-in-place structural concrete. Included are methods and procedures for obtaining quality concrete through proper handling, placing, finishing, curing, and repair of surface defects.

1.2 SUBMITTALS

A. Submit the following data unless otherwise specified:

1. Field Control Test Reports. Maintain and submit accurate records of all test and inspection reports.
2. Conveying Equipment. Submit description of conveying equipment.
3. Temperature Measurement. Submit proposed method of measuring concrete surface temperature changes.
4. Repair Methods. When stains, rust, efflorescence, and surface deposits must be removed, submit the proposed method of removal.
5. Placement Notification. Submit notification at least 24 hours in advance of concrete placement.
6. Replacement Requirements. Submit requests for acceptance of reinforcement and form placement at least 48 hours in advance of concrete placement.
7. Wet Weather Placement. When placement is scheduled during wet weather, submit request for acceptance of protection.
8. Hot or Cold Weather Placement. When placement of concrete is subject to the requirements of Section 03 05 10 Cold Weather Concreting or Section 03 05 20 Hot Weather Concreting, submit request for placement along with the submittals required by those sections.

B. Submit the following data when required:

1. Matching Sample Finish. When special finishes are required by Contract Documents, submit sample finish.

2. Exposed Aggregate Surface. When an exposed aggregate surface is specified and a chemical retarder is proposed to be used, submit specification and data on the retarder and proposed method of use of retarder.
- C. Submit the following data with the placement shop drawings:
1. Construction Joints. Submit information for acceptance of proposed location and treatment of construction joints proposed by the contractor and shown on the Contract Drawings. Show locations, dimensions, blockouts, openings and details of all electrical, mechanical and structural embedded items associated with individual lifts or concrete pours.
 2. Two-Course Slabs. When a bonding agent other than cement grout is proposed, submit specification and data of bonding agent.
 3. Underwater Placement. When underwater placement is planned, submit request for acceptance of proposed method.
 4. Saw Cut Joints. When sawcut joints other than those indicated on the Contract Drawings are proposed, submit request of the proposed method.
 5. Moisture-Preserving Method. When a moisture-preserving method other than specified in 3.06.C is proposed, submit request of the proposed method.
 6. Repair Material. When repair material is proposed, submit the repair material specification, data on the proposed patching material, and proposed preparation and application procedure.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. DELIVERY: Place concrete within the time limits required in Specification Section 03 31 00, Concrete Mixtures.
- B. STORAGE AND HANDLING: Store and handle products to retain original quality. Do not use products stored beyond the manufacturer's recommended shelf life.

PART 2 PRODUCTS

2.1 MATERIALS

- A. CURING COMPOUNDS: Where the use of curing compounds is approved, use curing compounds that conform to ASTM C309. Curing compound shall be translucent with fugitive dye. Combination curing compound/sealer products shall not be used unless sealer is part of the specified finish.

Where concrete is to be coated with moisture- or waterproofing compound or sealer, curing compounds shall not be used unless certified by the manufacturer as not adversely affecting the bond or performance of subsequently applied coatings, or shall be removed after completion of the cure using light water blast in accordance with manufacturer's recommendations.

- B. SHEET MATERIALS FOR CURING CONCRETE: Use sheeting materials that conform to ASTM C171.
- C. BONDING GROUT: Use bonding grout in accordance with 3.6.D, Preparation of Bonding Grout.
- D. SITE-MIXED PORTLAND CEMENT REPAIR MORTAR: Use repair mortar in accordance with 3.6.E, Site-Mixed Portland Cement Repair Mortar.
- E. FLOOR HARDENER: Floor hardener shall be a graded, iron aggregate base compound for dry-shake application and trowel embedment into fresh concrete. The compound shall be packaged in 90-lb, poly-lined bags and shall contain a dispersing agent, Portland cement and a stable lime-proof pigmentation to color the application gray. Wet cure or use curing compound recommended by the hardener manufacturer.
- F. FLOOR SEALER: See Division 09.

PART 3 EXECUTION

3.1 PREPARATION

- A. Do not place concrete until data on materials and mixture proportions are accepted.
- B. Remove hardened concrete and foreign material from the inner surfaces of conveying equipment.
- C. Before placing concrete in forms, complete the following:
 - 1. Remove snow, ice, frost, water, and other foreign material from surfaces, including reinforcement and embedded items, against which concrete will be placed.
 - 2. Position and secure in place expansion joint material, anchors, and other embedded items.
- D. Before placing a concrete slab on grade, clean foreign material from the subgrade and complete the following:
 - 1. Subgrade shall be well drained and of uniform load-bearing nature.

2. In-place density of subgrade soils shall be uniform throughout the area and at least the minimum required by Contract Documents.
 3. Subgrade shall be free from frost or ice.
 4. Subgrade shall be moist with no free water and no muddy or soft spots.
- E. When high ambient temperatures necessitate protection of concrete immediately after placing or finishing, make provisions in advance of concrete placement for windbreaks, shading, fogging, sprinkling, ponding, or wet covering.

3.2 PLACEMENT OF CONCRETE

A. WET CONSIDERATION

1. Wet Weather. Do not begin to place concrete while rain, sleet, or snow is falling unless adequate protection is provided and approval of protection is obtained.
2. Do not allow rain water to increase mixing water or to damage the surface of the concrete.
3. Concrete Placed In Water. No concrete shall be placed underwater or in standing water unless specifically directed and as provided for in these Specifications and shown on the Contract Drawings. Underwater concrete shall be placed using tremies or other special methods subject to approval, and only concrete mixtures specifically formulated for underwater placement shall be used.

B. CONVEYING: Convey concrete from mixer to the place of final deposit rapidly by methods which prevent segregation or loss of ingredients and will assure the required quality of concrete. Do not use aluminum pipes or chutes.

C. CONVEYING EQUIPMENT: Use acceptable conveying equipment of a size and design that will prevent cold joints from occurring. Clean conveying equipment before each placement.

1. Use belt conveyors that are horizontal or at a slope that will not cause excessive segregation or loss of ingredients. Project concrete to minimize drying and the effects of temperature rise. Use an acceptable discharge baffle or hopper at the discharge end to prevent segregation. Do not allow mortar to adhere to the return length of the belt.
2. Use metal or metal-lined chutes having rounded bottoms, and sloped between 1 vertical to 2 horizontal and 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting slope requirements may be used provided the discharge is into a hopper before distributing into the forms.

3. Use pumping conveying equipment that permits placement rates that avoid cold joints and prevents segregation in discharge of pumped concrete.
- D. DEPOSITING: All concrete shall be delivered, discharged, and placed within the time limits specified in Concrete Mixtures.

Deposit concrete continuously in one layer or in layers to have fresh concrete deposited on in-place concrete that is still plastic. Do not deposit fresh concrete on concrete that has hardened sufficiently to cause formation of seams or planes of weakness.

Once concreting is started, it shall be carried on as a continuous operation until the placing of the panel or section is complete. Suspension of operations for more than 1½ hours will not be permitted during a continuous placement.

Concrete shall be placed generally in horizontal layers not more than 24 inches thick, except as otherwise specified. Each layer of concrete is regarded as a unit of masonry to be laid and worked before the succeeding layer can be superimposed in the process of monolithic construction. When a monolithic layer cannot be completed in one operation, it shall be terminated with a vertical bulkhead. Feathering out to less than 6 inches will not be permitted.

Concrete shall be placed so as to prevent segregation of the materials and the displacement of the reinforcement. Where placing operations would involve the dropping of concrete through completed forms from heights of 4 or more feet, concrete so placed shall be pumped or discharged into hoppers feeding into flexible drop chutes to within 2 feet of the concrete's final deposition point. Encrustation of installed reinforcement by concrete spilled on it will be tolerated only for a length of time shorter than the encrustating concrete needs for drying out.

Do not use concrete that has surface dried, partially hardened, or contains foreign material.

When temporary spreaders are used in the forms, remove the spreaders as their service becomes unnecessary. Spreaders made of metal or concrete may be left in place if prior acceptance is obtained.

Do not place concrete over columns and walls until concrete in columns and walls is no longer plastic and has been in place at least 1 hour.

Place concrete for beams, girders, brackets, column capitals, haunches, and drop panels at the same time as concrete for slabs.

When placing concrete for columns, do not exceed the top-of-pour elevation indicated on the Contract Drawings for the joint between the column and the slab or drop panel it supports.

When underwater placement is required or permitted, place concrete by an acceptable method. Deposit fresh concrete so concrete enters the mass of the previously placed concrete from within, displacing water with minimum disturbance to the surface of concrete.

- E. CONSOLIDATING: Consolidate concrete by vibration. Concrete shall be thoroughly worked around reinforcement and embedded items and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Use internal vibrators of the largest size and power that can properly be used in the work. Workers shall be experienced in use of the vibrators. Do not use vibrators to move concrete within the forms.

The Contractor shall supply enough vibrators to consolidate the concrete (except that placed underwater) according to the requirements of this Section. Each vibrator must:

1. Be designed to operate while submerged in the concrete;
2. Vibrate at a rate of at least 7,000 pulses per minute; and

Immediately after concrete is placed, vibration shall be applied in the fresh batch at the point of deposit. In doing so, the Contractor shall:

3. Space the vibrators evenly, no farther apart than twice the radius of the visible effects of the vibration;
4. Ensure that vibration intensity is great enough to visibly affect a weight of 1 inch slump concrete across a radius of at least 18 inches;
5. Insert the vibrators slowly to a depth that will effectively vibrate the full depth of each layer, penetrating into the previous layer on multilayer pours;
6. Protect partially hardened concrete (i.e., nonplastic, which prevents the vibrator penetration when only its own weight is applied) by preventing the vibrator from penetrating it or making direct contact with steel that extends into it;
7. Not allow vibration to continue in one place long enough to form pools of grout;
8. Continue vibration long enough to consolidate the concrete thoroughly, but not so long as to segregate it;
9. Withdraw the vibrators slowly when the process is complete; and
10. Not use vibrators to move concrete from one point to another in the forms.

When vibrating and finishing top surfaces that will be exposed to weather or wear, the Contractor shall not draw water or laitance to the surface. In high lifts, the top layer

shall be shallow and made up of a concrete mix as stiff as can be effectively vibrated and finished.

To produce a smooth, dense finish on outside surfaces, the Contractor shall hand tamp the concrete.

- F. CONSTRUCTION JOINTS AND OTHER BONDED JOINTS: Locate construction joints as indicated on the Contract Drawings. Formed construction joints shall be thoroughly cleaned, laitance removed, and dampened prior to placement of fresh concrete. When bond is required or permitted, it shall be achieved by one of the following:
1. Use an acceptable adhesive applied in accordance with the manufacturer's recommendations.
 2. Use an acceptable surface retarder in accordance with the manufacturer's recommendations.
 3. Roughen the surface to ¼" amplitude in an acceptable manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, or damaged concrete at the surface. The concrete surface shall be observed to be clean immediately prior to subsequent concrete pour.
 4. Use portland cement grout of the same proportions as the mortar in the concrete in an acceptable manner.
- G. CONTRACTION/CONTROL JOINTS: The location of contraction or control joints shall be as shown or specified on the plans. Contraction joints shall be saw cut, preformed, or tooled ¼ inch wide by 1/4th of the slab depth, but not less than 1½ inches deep, unless otherwise detailed on the Contract Drawings. Saw cut joints shall be completed as soon as the concrete has hardened. Contraction joints shall be finished with backing rod and sealant.
- H. PIPE PENETRATIONS: Where pipes pass through the structure, they shall be cast in place, unless noted otherwise in the Contract Drawings. Whenever these requirements interfere with the placement of reinforcing steel as indicated by the Contract Drawings, the bars shall be spread and rearranged as detailed in the Contract Drawings.

3.3 FINISHING UNFORMED SURFACES

- A. PLACEMENT: Place concrete at a rate that allows spreading, straight-edging, and darbying or bullfloating before bleed water appears.

Strike smooth the top of walls, buttresses, horizontal offsets, and other similar unformed surfaces, and float them to a texture consistent with finish of adjacent formed surface.

Table 3.4.A: Finish Schedule

<u>LOCATION</u>	<u>FINISH TYPE</u>
Slab-on-Grade Floors	Troweled Finish (with floor hardener / sealer)
Sidewalks & Exterior Slabs	Broom Finish

B. FINISHES

1. Troweled Finish. Float concrete surface, then power trowel the surface. Hand trowel the surface smooth and free of trowel marks. Continue hand troweling until a ringing sound is produced as the floor is troweled. Tolerance for concrete floors shall be conventional straightedge in accordance with ACI 117, unless otherwise specified. Concrete surfaces intended to support floor covering shall not have defects that will reflect through floor covering.
2. Broom or Belt Finish. Immediately after concrete has received a steel-troweled finish, give the concrete surface a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

C. FINISHING TOLERANCES FOR SLABS

1. Finish floor slabs to meet the requirements of ACI 117. Measure floor finish tolerances within 72 hours after slab finishing.
2. Unless otherwise specified in the Contract Documents, measure floor tolerances in accordance with the straightedge method in ACI 117.

3.4 SAWED CONTROL JOINTS

Where saw cut joints are required or permitted, start cutting as soon as concrete has hardened sufficiently to prevent dislodgement of aggregates. Saw a continuous slot to a depth of one-fourth the thickness of the slab but not less than one inch. Complete sawing within 6 hours after placement.

3.5 CURING AND PROTECTION

- A. GENERAL: Curing of poured concrete is required to prevent excess cracking. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury. Protect concrete during the curing period such that the concrete temperature does not fall below the requirements. Cure concrete for 7 days after placement. High early strength concrete shall be cured for 3 days after placement.

Table 3.6.A: Curing Method Schedule

<u>Location</u>	<u>Method</u>
All locations	Wet method or curing compound method

During and following curing, do not allow the surface of the concrete to change temperature more than the following:

- 50°F in any 24-hour period for sections less than 12 inches in the least dimension.
- 40°F for sections from 12 to 36 inches in the least dimension.
- 30°F for sections 36 to 72 inches in the least dimension.
- 20°F for sections greater than 72 inches in the least dimension.

B. **PRESERVATION OF MOISTURE:** After placing and finishing, use one of the following methods, to preserve moisture in concrete:

1. Wet Cure Method. Provide continuous moisture by ponding or watering a covering of heavy quilted blankets, by watering and covering with a white reflective-type sheeting, or by wetting the outside surfaces of wood forms. Runoff water shall be collected and disposed of in accordance with all applicable regulations. In no case shall runoff water be allowed to enter any lakes, streams, or other surface waters.

When curing slabs with wet heavy quilted blankets or burlap, a fog or mist spray of water shall be sprayed on the entire surface before the bleed water has evaporated. As soon as the concrete has achieved initial set, the surface shall be covered with presoaked heavy quilted blankets or burlap. The fog or mist spray shall be applied continuously until the presoaked heavy quilted blankets or burlap are placed. If the fog or mist spray cannot be applied continuously, two coats of curing compound shall be applied after the initial fog or mist spray application and before the presoaked heavy quilted blankets or burlap are placed.

Ponding may be used for slabs on grade.

2. Curing Compound Method. Application of a curing compound conforming to ASTM C309. Apply the compound in accordance with manufacturer's recommendation after water sheen has disappeared from the concrete surface and after finishing operations. The rate of application shall not exceed 150 square feet per gallon. Apply in two applications at right angles to each other, not to exceed 150 square feet per gallon for each coat. Do not use curing compound on any surface where concrete or other material will be bonded unless the curing compound will not prevent bond or unless measures are to be taken to completely remove the curing compound from areas to receive bonded applications.

No later than the morning after applying the curing compound, the Contractor shall cover the top surfaces with white, reflective sheeting, leaving it in place for at least 10 days. Throughout this period, the sheeting shall be kept in place by taping or weighting the edges.

3.6 REPAIR OF SURFACE DEFECTS

A. GENERAL: Repair tie holes and surface defects immediately after form removal. Where the concrete surface will be textured by sandblasting or bush-hammering, repair surface defects before texturing.

B. REPAIR OF TIE HOLES

1. Plug tie holes except where stainless steel ties, non-corroding ties, or acceptably coated ties are used.
2. When portland cement patching mortar is used for plugging, clean and dampen tie holes before applying the mortar.
3. When other materials are used, apply them in accordance with Manufacturer's recommendations.
4. Finish tie holes flush with surrounding wall.

C. REPAIR OF SURFACE DEFECTS OTHER THAN TIE HOLES: Outline honeycombed or otherwise defective concrete with a ½- to ¾-inch-deep saw cut, and remove such concrete down to sound concrete. When chipping is necessary, leave chipped edges perpendicular to the surface or slightly undercut. Do not feather edges. Dampen the area to be patched, plus another 6 inches around the patch area perimeter. Prepare bonding grout. Thoroughly brush grout into the surface.

When the bond coat begins to lose water sheen, and thoroughly consolidate mortar into place. Strike mortar leaving the patch slightly higher than the surrounding surface to permit initial shrinkage. Leave the patch undisturbed for 1 hour before finishing. Keep the patch damp for 7 days.

D. PREPARATION OF BONDING GROUT: For bonding grout, mix approximately one part of cement and one part of fine sand with water to a consistency of thick cream.

E. SITE-MIXED PORTLAND CEMENT REPAIR

1. Mix repair mortar using the same materials as concrete to be patched with no coarse aggregate. Use not more than one part cement to two and one-half parts sand by loose damp volume.

2. For repairs in exposed concrete, make a trial batch and check color compatibility of repair material with surrounding concrete. When the repair is too dark, substitute white portland cement for a part of the gray cement to produce a color closely matching surrounding concrete.
 3. Use a repair mortar at a stiff consistency with no more mixing water than is necessary for handling and placing. Mix the repair mortar and manipulate the mortar frequently with a trowel without adding water. Use mortar at a stiff consistency.
 4. Repair mortar may be used for holes at least 1 inch deep where the depth is equal to or greater than the smallest surface dimension of the defect, and for narrow slots cut for the repair of cracks. Do not use where lateral restraint cannot be obtained. Place and dry-pack mortar in layers having a compacted thickness of approximately 1/8th inch.
 5. Solidly compact each layer over its entire surface by use of a hardwood stick and hammer. Do not use metal tools for compacting. compact surface just flush with adjacent area. Do not use steel finishing tools or water to facilitate finishing.
- F. REPAIR MATERIALS OTHER THAN SITE-MIXED PORTLAND CEMENT MORTAR: Materials other than site-mixed portland cement may be used for repair when approved. Materials include, but are not limited to:
1. Shotcrete
 2. Commercial Patching Products. Including:
 - a. Portland cement mortar modified with a latex bonding agent, conforming to ASTM C1059 Type II.
 - b. Epoxy mortars and epoxy compounds that are moisture-insensitive during application and after curing, which embody an epoxy binder that conforms to ASTM C881, Type III. The type, grade, and class shall be appropriate for the application as specified in ASTM C881.
 - c. Shrinkage-compensating or non-shrink portland cement grout, conforming to ASTM C1107.
 - d. Packaged dry concrete repair materials, conforming to ASTM C928.
- G. REMOVAL OF STAINS, RUST, EFFLORESCENCE AND SURFACE DEPOSITS: Remove stains, rust efflorescence and surface deposits by acceptable methods.
- H. CONCRETE REPLACEMENT: Use concrete replacement for:

1. Holes extending entirely through concrete sections.
2. For holes larger than 1 square foot and deeper than 4 inches in which no reinforcement is encountered.
3. For holes larger than $\frac{1}{2}$ of 1 square foot where reinforcement is exposed.

Concrete used for replacement shall be the same strength and mixture as used in the structure.

END OF SECTION

SECTION 03 31 00

CONCRETE MIXTURES

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This section covers the requirements for materials, proportioning, production and delivery of concrete.

1.2 SUBMITTALS

- A. MIXTURE PROPORTIONS: Submit concrete mixture proportions and characteristics.
- B. MIXTURE PROPORTION DATA: Submit field test data used to establish the required average strength. Submit for acceptance test data used to establish the average compression strength of the mixture.
- C. CONCRETE MATERIALS: Submit the following information for concrete materials, along with evidence demonstrating compliance:
 - 1. For Cementitious Materials. Types, classes, producers' names, plant locations, and evidence not more than 90 days old.
 - 2. For Aggregates. Types, pit or quarry locations, producers' names, gradations, specific gravities and evidence not more than 90 days old.
 - 3. For Admixtures. Types, brand names, producers, catalog, and certification data.
 - 4. For Water and Ice. Source of supply.
- D. FIELD TEST DATA BASIS: When field test data is used as a basis for selecting proportions for a concrete mixture, submit data on materials and mixture proportions, with supporting test results confirming conformance with specified requirements.
- E. MIXTURE PROPORTION ADJUSTMENTS: Submit any adjustments to mixture proportions or changes in materials, along with supporting documentation, made during the course of the Work.
- F. FLOOR CONCRETE: Submit evaluations and test results verifying adequacy of concrete to be placed in floors when cementing content is less than the minimum specified.
- G. CALCIUM CHLORIDE: Calcium chloride shall not be added to the concrete.

- H. VOLUMETRIC BATCHING: When it is desired to produce concrete by the volumetric batch method, submit request along with description of proposed method.
- I. TIME OF DISCHARGE: When it is desired to exceed time for discharge of concrete required by ASTM C94, submit a request along with a description of the precautions to be taken.

1.3 QUALITY ASSURANCE

- A. The Contractor shall maintain records verifying materials used are of the specified and accepted types and sizes.
- B. The Contractor shall assure that production and delivery of concrete conform to the requirements.
- C. The Contractor shall assure that the concrete produced has the specified characteristics in the freshly mixed state and that they are maintained during transport and delivery.

1.4 MATERIALS STORAGE AND HANDLING

- A. CEMENTITIOUS MATERIAL: Store cementitious materials in dry weathertight buildings, bins, or silos which will exclude contaminants.
- B. AGGREGATES: Store and handle aggregate in a manner that will avoid segregation and prevent contamination with other materials or other sizes of aggregates. Store aggregates to drain freely.
- C. Do not use aggregates that contain frozen lumps.
- D. WATER AND ICE: Protect mixing water and ice from contamination during storage and delivery.
- E. ADMIXTURES: Protect and store admixtures against contamination, evaporation, or damage. Provide agitating equipment for admixtures used in the form of suspensions or non-stable solutions to ensure thorough distribution of ingredients. Protect liquid admixtures from freezing and from temperature changes which would adversely affect their characteristics.

PART 2 PRODUCTS

2.1 MATERIALS

- A. CEMENTITIOUS MATERIAL: Cementitious material shall consist of portland cement conforming to ASTM C150, with or without the addition of cementitious or pozzolanic

mineral admixtures conforming to ASTM C618 or ASTM C989, or blended hydraulic cement conforming to ASTM C595. Unless otherwise specified, cementitious material shall conform to ASTM C150 Type I or Type II, without the addition of cementitious or pozzolanic mineral admixtures. The tricalcium aluminum (Ca_3Al) content of the portland cement shall be less than 8 percent in all concrete. In addition, cement shall meet the heat of hydration limits of Table 4 in ASTM C150. Cement for shrinkage compensating concrete shall conform to ASTM C845.

Cementitious material used in concrete shall be the same brand and type, and from the same plant of manufacture as the cementitious material used in the concrete represented by the submitted field test data or used in the trial mixtures.

- B. AGGREGATES: Aggregates shall conform to ASTM C33 unless otherwise specified. When a single size or a combination of two or more sizes of coarse aggregates are used, the final gradation shall conform to the grading requirements of ASTM C33 unless otherwise specified or permitted.

Aggregates used in concrete shall be obtained from the same sources and have the same size ranges as the aggregates used in the concrete represented by submitted historical data, or used in trial mixtures.

- C. WATER AND ICE: Mixing water for concrete and water used to make ice shall meet the requirements of ASTM C94.

- D. ADMIXTURES: Admixtures shall meet the requirements of the following:

1. Provide admixtures produced and serviced by an established, reputable manufacturer, used in compliance with Manufacturer's recommendations. All of the admixtures used shall be from the same manufacturer and compatible with each other.
 - a. *Air-entraining admixture*: Conform to ASTM C260. Admixture shall contain no chlorides and shall be capable of maintaining the air percentage as batched, within $\pm 2\%$ at point of placement, for 2 hours.
 - b. *Water-reducing set, set-controlling admixture*: Conform to ASTM C494, Type A or D. Admixture shall contain no chlorides, and shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the Manufacturer's recommendations to obtain at least 12% water reduction. No retarder shall be used without approval. Submit written proposed details of use.
 - c. *Non-chloride, non-corrosive accelerators* Conform to ASTM C494, Type E, Admixture, shall be non-chloride and shall not promote corrosion of reinforcing steel in concrete.

- d. *High-range water reducer*: Conform to ASTM C494, Type F or G. The admixture shall be free of chlorides and alkalines. Water reducers shall be batch plant added.
- e. *Fly ash*: ASTM C618, Class F, maximum 2% loss on ignition.
- f. *Fiber reinforcement*: Fiber reinforcement shall be nominal ½-inch fibrillated polypropylene, Fibermesh, W.R. Grace, or other approved polypropylene product designed specifically for control of shrinkage and drying cracking in portland cement concrete.
- g. *Retarding admixture*: Confirm to ASTM A494, Type B.

Admixtures used in concrete shall be the same as those used in the concrete represented by submitted field test data or used in trial mixtures.

- E. CHANGE OF MATERIALS: When brand type, size, or source of cementitious materials, aggregates, water, ice, or admixtures are proposed to be changed, new field data or data from new trial mixtures or evidence which indicates that the change will not adversely affect the relevant properties of the concrete shall be submitted for acceptance prior to use in concrete.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

A. CEMENTITIOUS MATERIAL CONTENT

1. The cementitious material content shall be adequate for concrete to satisfy the specified requirements for strength, water-cement ratio, and finishing ability. Not more than 20% fly ash may be substituted for portland cement at the Contractor's option. However, mix designs with fly ash shall not be used for floor slabs.
2. For concrete used in floors, cement content shall not be less than indicated on the Contract Drawings. Acceptance of a lower cement content will be contingent upon verification that concrete mixtures with a lower cement content will meet the specified strength requirements and will produce concrete with equal finish quality, appearance, durability, and surface hardness.
3. When a history of finishing quality is not available, evaluate the proposed mixture by placing concrete in a slab at the job using job materials, equipment, and personnel. The slab shall be at least 8 feet square and have an acceptable thickness. Slump shall not exceed the specified slump. Submit the evaluation results for acceptance.

Table 2.2.A: Minimum Cement Content Requirements

Nominal Maximum Size of Aggregate (in.)	Minimum Cement Content(lb/yd)
1½	470*
1	520
¾	540
3/8	610

* Minimum cement content shall be 501 lb/yd³ if concrete will be exposed to freezing and thawing in the presence of de-icing chemicals.

- B. SLUMP: Concrete shall have, at the point of placement, slump in accordance with Table 2.2.B. Determine the slump by ASTM C143. Slump tolerances shall meet the requirements of ACI 117.

Concrete with a high-range water reducing admixture may exceed the maximum slump by 2 inches while the admixture is effective.

Table 2.2.B: Slump Schedule

	Maximum	Minimum
Slabs	4"	2"
Footings	4"	2"
Walls	5"	2"

- C. SIZE OF COARSE AGGREGATE: Except when otherwise specified or permitted, nominal maximum size of coarse aggregate shall not exceed ¾ of the minimum clear spacing between reinforcing bars or 1/5 of the narrowest dimension between sides of forms.

D. AIR CONTENT

1. Unless otherwise specified, all concrete shall be air-entrained. Unless otherwise specified, air content at the point of delivery shall conform to the requirements of Table 2.2.D for moderate exposure.
2. For specified compressive strengths above 5,000 psi, the total air contents indicated in Table 2.2.D may be reduced by 1 percent.
3. Air content shall be measured in accordance with ASTM C138, C173, or C231. ASTM C231 shall be the preferred method.
4. Maximum air entrainment shall not exceed 3 percent for interior floor slabs to receive floor hardener and sealing compound.

Table 2.2.D: Total Air Content* of Concrete for Various Sizes of Coarse Aggregate

Nominal Max. Size of Aggregate (in.)	Total Air Content, + Percent		
	Severe Exposure	Moderate Exposure	Mild Exposure
Less than 3/8	9	7	5
3/8	7.5	6	4.5
1/2	7	5.5	4
3/4	6	5	3.5
1	6	4.5	3
1 1/2	5.5	4.5	2.5
2	5	4	2
3	4.5	3.5	1.5
6	4	3	1

*Measured in accordance with ASTM C138, C173, or C231.

+Air content tolerance is +1-1 1/2 percent.

- E. ADMIXTURES: When admixtures are specified in the Contract Documents for particular parts of the Work, use the types specified.
1. Water-reducing admixtures may be used at the option of the Contractor.
 2. Accelerators shall not be used without approval.
- F. CONCRETE CLASS AND LOCATION: The proportions of cement, aggregate, and water for concrete shall be determined by the Contractor and subject to the requirements of this Section. Concrete shall meet the following criteria:

Property	Class A	Class B	Class C
Cement type	C150 Type 2	C150 Type 2	C150 Type 2
Max. water/cementitious ratio	0.45	0.45	0.45
Entrained air	Yes	Yes	No
Compressive strength at 28 days	4,000 psi	4,000 psi	4,000 psi

Class	Location
A	Footings
B	Walls and Exterior Slabs
C	Slab-on-Grade (Interior Only)

G. CONCRETE TEMPERATURE: When the average of the highest and lowest temperature during the period from midnight to midnight is expected to drop below 40°F for more than 3 successive days, concrete shall be delivered to meet the following minimum temperature immediately after placement:

- 55°F for sections less than 12" in the least dimension
- 50°F for sections 12" to 16" in the least dimension
- 45°F for sections 36" to 72" in the least dimension
- 40°F for sections greater than 72" in the least dimension

The temperature of concrete as placed shall not exceed these values by more than 20°F.

These minimum requirements may be terminated when temperatures above 50°F occur during more than half of any 24-hour duration.

Unless otherwise specified or permitted, the temperature of concrete as delivered shall not exceed 90°F.

H. STRENGTH AND WATER-CEMENTITIOUS MATERIAL RATIO: The compressive strength and, when required, the water-cementitious material ratio of the concrete for each portion of the work shall be as specified in Paragraph F above.

1. If cementitious or pozzolanic mineral admixtures conforming to ASTM C618 or ASTM C989 are used, the cement portion of the water-cement ratio shall be the total weight of cementitious materials.
2. The maximum weight of fly ash, pozzolan or ground granulated blast-furnace slag that is included in the calculation of water-cementitious material ratio shall not exceed the following percentages of the total weight of Portland cement plus fly ash, pozzolan, and ground granulated blast-furnace slag.
 - a. The combined weight of fly ash and pozzolan conforming to ASTM C618 shall not exceed 25 percent of the total weight of cementitious material. The fly ash and pozzolan present in an ASTM Type IP or IPM blended cement conforming to ASTM C595 shall be included in the calculated percentage.
 - b. The weight of ground granulated blast-furnace slag conforming to ASTM C989 shall not exceed 50 percent of the total weight of cementitious material. The slag used in manufacture of Type IS or ISM blended hydraulic cement conforming to ASTM C595 shall be included in the calculated percentage.
 - c. If fly ash or pozzolan is used in concrete with ground granulated blast-furnace slag, the portland cement constituent conforming to ASTM C150 shall not be less than 50 percent of the total weight of cementitious material. Fly ash or

pozzolan shall constitute no more than 20 percent of the total weight of cementitious material.

3. Unless otherwise specified, strength requirements shall be based on the 28-day compressive strength determined on 6"x12" cylindrical specimens made and test in accordance with ASTM C31 and C39, respectively.

2.3 PROPORTIONING

- A. Proportion concrete to conform with 2.2, Performance and Design Requirements, to provide workability and consistency so concrete can be worked readily into forms and around reinforcement without segregation or bleeding, and to provide an average compressive strength adequate to meet acceptance requirements.

If the production facility has records of field tests performed within the past 12 months and spanning a period of not less than 60 calendar days for a class of concrete within 1,000 psi of that specified for the Work, calculate a standard deviation and establish the required average strength f_c' . If field test records are not available, select the required average strength.

- B. STANDARD DEVIATION: Where a concrete production facility has test records, a standard deviation shall be established. Test records from which a standard deviation is calculated:
 1. Must represent materials, quality control procedures, and conditions similar to those expected, and changes in materials and proportions within the test records shall not have been more restricted than those for proposed work.
 2. Must represent concrete produced to meet a specified strength or strengths f_c' within 1,000 psi of that specified for the proposed work.
 3. Must consist of at least 30 consecutive tests, or two groups of consecutive tests, totaling at least 30 tests, except as provided below.
 4. Where a concrete production facility does not have test records meeting the above requirements, but does have a record based on 15 to 29 consecutive tests, a standard deviation must be established as the product of the calculated standard deviation and the modification factor. To be acceptable, the test record must meet the requirements of Items 1 and 2 and represent only a single record of consecutive tests that span a period of not less than 45 calendar days.
- C. REQUIRED AVERAGE COMPRESSIVE STRENGTH: Calculate the required average compressive strength f_{cr}' for the specified concrete in accordance with one of the following:

1. Use the standard deviation calculated in accordance with 2.3.B to establish the required average compressive strength as follows:

$$F_{cr}' = F_c' + 1.34 ks$$

$$F_{cr}' = F_c' + 2.33 ks - 500$$

where:

F_{cr}' = required average compressive strength

F_c' = specified compressive strength

s = Standard deviation calculated in accordance with 2.3.B

k = factor from Table 2.3.C.1 for increase in standard deviation if the total number of tests is less than 30

The larger of the two values of F_{cr}' calculated in accordance with 2.3.C.1 shall be used.

Table 2.3.C.1: k -Factor for Increasing the Standard Deviation for Number of Tests Considered

Total No. of Tests Considered	k -Factor for Increasing Standard Deviation
15	1.16
20	1.08
25	1.03
30 or more	1.00

Linear interpolation for intermediate number of tests is acceptable.

2. When field test data is not available to establish a standard deviation, select the required average compressive strength F_{cr}' from Table 2.3.C.2.

Table 2.3.C.2: Required Compressive Strength F_{cr}' When Data Is Not Available to Establish a Standard Deviation

Specified strength, F_c'	Required average Compressive Strength, F_{cr}'
Less than 3,000 psi	$F_c' + 1,000$ psi
3,000 to 5,000 psi	$F_c' + 1,200$ psi
Over 5,000 to 10,000 psi	$F_c' + 1,400$ psi
Over 10,000 to 15,000 psi	$F_c' + 1,800$ psi

- D. DOCUMENTATION OF REQUIRED AVERAGE COMPRESSIVE STRENGTH: Documentation demonstrating that the proposed concrete proportions will produce an average compressive strength equal to or greater than the required average compressive strength F_{cr}' shall consist of field strength records or trial mixtures.

1. Field Test Data. If field test data is available and represents a single group of at least 15 consecutive strength tests for one mixture, using the same materials and under the same conditions encompassing a period of not less than 60 days, verify that the average of the field test results equals or exceeds F_c' . Submit for acceptance the mixture proportions along with the field test data.

If the field test data represents two groups of compressive strength tests for two mixtures, plot the average strength X_1 and X_2 , of each group versus the corresponding mixture proportions, and interpolate between corresponding mixture proportions to establish mixture proportions for F_c' .

2. Trial Mixtures. Establish mixture proportions based on trial mixtures in accordance with the following requirements:
 - a. Use materials and material combinations proposed for the Work.
 - b. Determine the required average compressive strength.
 - c. Make at least 3 trial mixtures complying with 2.2, Performance and Design Requirements. Each trial mixture shall have a different cementitious material content. Select water-cementitious material content. Select water-cementitious material ratios that will produce a range of compressive strengths encompassing the required average compressive strength F_{cr}' .
 - d. Proportion trial mixtures to produce a slump within $\frac{3}{4}$ " of the maximum specified, and for air-entrained concrete, an air content within 0.5 percent of the required total air content indicated in Table 2.2.D. The temperature of the freshly mixed concrete shall be recorded, and shall be within 10°F of the intended maximum temperature of the concrete as mixed and delivered.
 - e. For each trial mixture, make and cure 3 compressive strength cylinders for each test age in accordance with ASTM C192. Test for compressive strength in accordance with ASTM C39 at 28 days or at the test age specified in the Contract Documents.
 - f. From results of these tests, plot a curve showing the relationship between water-cementitious material ratio and compressive strength.
 - g. From the curve of water-cementitious material ratio versus compressive strength, select the water-cementitious material ratio corresponding to the required average compressive strength F_c' . This is the maximum water-cementitious material ratio that may be used to establish mixture proportions unless a lower water-cement ratio is specified.
 - h. Establish mixture proportions so that the maximum water-cementitious material ratio is not exceeded when slump is at the maximum specified.

- E. FIELD VERIFICATION OF ADEQUACY OF SELECTED PROPORTIONS: Using materials accepted for use in the Work, verify in the field the adequacy of the selected proportions to produce concrete with the required total air content and consistency, and with workability compatible with the intended placing method. Make suitable corrections as necessary and submit for acceptance the adjusted proportions.
- F. REVISIONS TO CONCRETE MIXTURES: When 15 consecutive compressive strength test results become available from the field, calculate the actual average compressive strength and standard deviation. Calculate a revised value for the average required compressive strength F_{cr}' .
 - 1. When the actual average compressive strength X exceeds the revised value of F_c' and requirements of 2.3.F are met, the required average compressive strength of the concrete F_c' may be decreased if the requirements of 2.2 are met.
 - 2. If the actual average compressive strength X is less than the revised value of F_c' , or if either of the two requirements in 2.3.F are not met, take immediate steps to increase average compressive strength of the concrete.
 - 3. Revised mixture proportions shall be submitted for acceptance prior to placing in the Work.

PART 3 EXECUTION

3.1 MEASURING, BATCHING AND MIXING

Production facilities shall produce concrete of the specified quality and conforming to the requirements of this Specification.

- A. READY-MIXED AND SITE-PRODUCED CONCRETE: Unless otherwise specified, measure, batch and mix concrete materials and concrete in conformance with ASTM C94.
- B. CONCRETE PRODUCED BY VOLUMETRIC BATCHING AND CONTINUOUS MIXING: When concrete made by volumetric batching and continuous mixing is permitted, it shall conform to the requirements of ASTM C685.
- C. PREPACKAGED DRY MATERIALS USED IN CONCRETE: If packaged dry combined materials are used, they shall conform to the requirements of ASTM C387.

3.2 DELIVERY

Deliver concrete which will possess the specified characteristics in the freshly mixed state at the point of placing. Transport and deliver concrete in equipment conforming to the requirements of ASTM C94.

- A. SLUMP ADJUSTMENT: When concrete arrives at the point of delivery with a slump below that which will result in the specified slump at the point of placement and is unsuitable for placing at that slump, the slump may be adjusted to the required value by adding water up to the amount allowed in the accepted mixture proportions. Addition of water shall be in accordance with ASTM C94. Do not exceed the specified water-cementitious material ratio or slump. Do not add water to concrete containing a plasticizing or a high-range, water-reducing admixture. Do not add water to concrete delivered in equipment not acceptable for mixing.

Measure slump and air content of air-entrained concrete, after slump adjustment, to verify compliance with specified requirements.

- B. TIME OF DISCHARGE: Time for completion of discharge shall be within 60 minutes of the first addition of cement to the truck.

This length of time may be extended, on a case-by-case basis, an additional 30 minutes at the discretion of the Owner's Representative provided the mix remains fluid and placeable and shows no signs of stiffening or set.

If delivery logistics make it impractical to discharge concrete within the above time limits, the Contractor may use an approved retarder admixture, delay the introduction of mixing water until the truck is closer to the job site, or propose other means, subject to approval, to assure that concrete is in acceptable condition at the time of discharge.

- C. BATCH TICKET INFORMATION

1. The manufacturer of the concrete shall furnish to the Contractor and to the Owner's Representative with each batch of concrete before unloading at the site, a delivery ticket on which is printed, stamped, or written, information concerning said concrete as follows:
 - a. Name of ready-mix batch plant
 - b. Serial number of ticket
 - c. Date
 - d. Truck number
 - e. Name of purchaser
 - f. Specific designation of job (name and location)
 - g. Specific class or designation of the concrete in conformance with that employed in job specifications

- h. Amount of concrete in cubic yards (or cubic meters)
- i. Time loaded or of first mixing of cement and aggregates
- j. Water added by receiver of concrete and his initials
- k. Reading of revolution counter at the first addition of water
- l. Type and brand, and amount of cement
- m. Type and brand, and amount of admixtures
- n. Information necessary to calculate the total mixing water added by the producer. Total mixing water includes free water on the aggregates, water, and ice batched at the plant, and water added by the truck operator from the mixer tank
- o. Maximum size of aggregate
- p. Weights of fine and coarse aggregate
- q. Ingredients certified as being previously approved
- r. Signature or initials of ready-mix representative

The Contractor shall keep a record of where in the work each batch was placed.

END OF SECTION

SECTION 03 62 00
NON-SHRINK GROUT

PART 1: GENERAL

1.1 Description of Work

This Section covers the supply of materials, mixing of materials, and the installation of various grades of grouts utilized in the project, for general purposes.

1.2 Standards and Codes

- A. 2018 International Building code
- B. ASTM C5 – Specification for Quicklime for Structural Purposes
- C. ASTM C33 – Concrete Aggregates
- D. ASTM C150 – Portland Cement

1.3 Submittals

- Manufacturer’s data on all products.

PART 2: PRODUCTS

2.1 Epoxy-Resin-Base Bonding System

For all grouted pipe penetrations, where called for on the drawings and in all cases where less than a 1-inch thickness of grout or mortar overlays existing concrete or green concrete, a bonding system complying with ASTM C881 shall be used, such as Sonobond by Sonneborn or equal.

2.2 Precision Grout

Filling of anchor bolt pockets, handrail pockets, and under equipment and column base plates shall be classified as precision grouting. Grout used for precision grouting shall be a pre-packaged, non-shrink grout using a mixture of metallic and natural aggregates, and shall conform to the most current version of ASTM 1107 Grade B or C when tested at a fluid consistency of 25-30 seconds per ASTM C939 at temperature extremes of 45 and 90°F and an extended working time of 30 minutes. Master Builders Embeco 636 or 885 are acceptable brand and grout types conforming to this specification.

All material used, including water, mixer and pre-packaged grout must be initially at the 45 and 90°F limits when testing is initiated. Manufacturer shall provide independent certification of ASTM C1107, compliance without modification of standard methods, and certify that the grout's post-hardening, non-shrink property is not based on gas expansion.

Grout shall have strengths of 3000 psi at 3 days, 5000 psi at 7 days, and 7000 psi at 28 days when cured at 72°F, as well as meet the 3-, 7-, and 28-day strengths when tested and cured at the 45 and 90°F limits, and shall not bleed when placed at a fluid consistency.

The Contractor shall engage an independent testing laboratory to run a 24-hour grout evaluation of any grout submitted for approval and shall submit written certification from the laboratory of conformance to all aspects of this specification.

2.3 Portland Cement Grout

Portland Cement Grout shall be used to provide flow concentration in channels, at the bottom of high walls, and in other locations where a general purpose grout is required. Portland cement grout shall be mixed with sand on a ratio of one part cement to two parts sand with an expansive agent included to limit drying shrinkage. Sufficient water shall be added for placement while maintaining a minimum 4,000 psi 28-day compressive strength.

2.4 Topping Course Grout

This grout shall be used for leveling the bottom of structures. This mix shall contain 6½ sacks of cement per cubic yard of concrete, use sand and 3/8-inch course aggregate, size No. 89 in ASTM C404, and use water-reducing and expansive additives. The minimum compressive strength shall be 4,000 psi in 28 days.

2.5 Rapid Cure Grout

Rapid cure grout shall be mixed with aggregate as recommended by the manufacturer. The grout shall be Master Builders Set 45 or equal.

2.6 Self-Leveling Underlayment

Self-leveling cement underlayment shall be Ardex K-15. The compressive strength shall be 4,000 psi per ASTM C109 and shall be capable of feather-edge thickness application. Self-leveling cement underlayment shall be used to level floors where noted on the drawings.

PART 3: EXECUTION

3.1 Mixing

All parts of the respective grouts shall be proportioned by volume measurement. Mixing shall be accomplished using a mechanical mixer suitable to the required quantities. Each batch shall be mixed for not less than 5 minutes. The respective grouts and mortars shall be mixed with sufficient water to maintain the fluidity required while attaining the minimum compressive strength indicated.

3.2 Retempering and Time Limit

Do not retemper or use mortar which has become harsh and nonplastic. When mortar has been maintained plastic and grout fluid, they may be used up to, but not more than, one hour after original mixing.

3.3 Temperature

Grouting operations shall not commence when the ambient temperature has dropped below 45°F or when the surface to which it is being applied is less than 40°F.

3.4 Protection

All grouting operations shall be protected against moisture intrusion and a sealer, linseed oil or Thoroclear 777, shall be applied at the completion of the work.

3.5 Surface Preparation

The existing concrete surface that the respective grout or mortar shall be placed against shall be cleaned as follows:

- A. If the existing surface has been exposed to sludge, chlorine, or other solutions, or was previously painted or treated, the surface shall be sandblasted and steam-cleaned, then treated with a diluted solution of muriatic acid neutralized with an alkaline solution and flushed with clean water.
- B. If the existing surface was not exposed to solution other than water, then the surface shall be washed with a diluted (2 parts water to 1 part acid) solution of muriatic acid, neutralized with an alkaline solution, and flushed with clean water.

3.6 Precision Grouting

This section describes additional special provisions for the grouting of anchor bolts, handrail pockets, and column and equipment baseplates, defined herein as precision grouting.

All grout used for precision grouting shall be placed in a fluid consistency, with an efflux time of 25 to 30 seconds through a standard flow cone as defined by ASTM C939. The Contractor shall have a standard flow cone on-site to verify grout consistency prior to placement.

Contractor shall not mix more grout than can be placed in approximately 10 minutes. Contractor shall not attempt to retemper grout by adding water or remixing after it stiffens.

All grout used for filling under column and machinery base plates shall be placed from one side using a form around the grouted area. A beveled form edge shall be provided on one side to help direct the grout flow under the base plate. Do not vibrate grout. Immediately after placement, trim the surfaces with a trowel and cover the exposed grout with clean, wet rags and maintain this moisture for 4 to 6 hours.

Forms and excess grout shall be removed after the grout has achieved initial set. The grout should offer stiff resistance to penetration with a pointed mason's trowel prior to removing the grout forms. Exposed shoulders shall be finished and wet cured immediately after form removal, and until grout has reached final set, but not less than 48 hours, followed by two coats of curing compound.

END SECTION

DIVISION 04 - MASONRY

SECTION 04 10 00

MORTAR AND GROUT

PART 1 GENERAL

1.1 SCOPE

Work under this section shall include all labor, materials and equipment required to complete work required by contract documents.

1.2 SUBMITTALS

- A. Submit grout design for review and approval, indicating type and proportions of the ingredients according to the proportion requirements herein and ASTM C 476, or submit the mix designs and grout strength test performed in accordance with ASTM C 476.
- B. Submit mortar design for review and approval, indicating type and proportions of ingredients in compliance with the proportion specification herein and ASTM C 270, or submit the mix design and mortar tests performed in accordance with the property specification of ASTM C 270.
- C. Submit color samples for OWNER selection of mortar color.
- D. Submit material certificates certifying that each material is in compliance for all Mortar and Grout materials and admixtures.
- E. Submit construction procedures for Cold Weather Construction and/or Hot Weather Construction for review and approval in compliance with the requirements herein prior to use on the project.

1.3 QUALITY ASSURANCE

- A. Testing Service –A testing laboratory shall be engaged to perform material evaluation tests and to perform required Special Inspections.
- B. Materials and installed work may require testing and retesting, at any time during the progress of the work. Allow free access to material stockpiles and facilities at all times.

- C. An independent testing agency or laboratory shall make test specimens of grout and mortar on job site. One mortar test and one grout test shall be taken for each 2,000 square feet of wall area but at least one set of tests shall be taken. The use of testing and inspection does not relieve the CONTRACTOR of the responsibility to furnish materials and construction in full compliance with the Contract Documents.
- D. Masonry construction shall be inspected and evaluated in accordance with the requirements of International Building Code (IBC), and shall be governed by the classification of the building or structure or nature of occupancy to either Level 1 inspection or Level 2 inspection. The Contract Documents shall dictate the required level of inspection per above reference, or provide a project specific special inspection program. If the Contract Drawings do not specify the level of required inspection the CONTRACTOR shall provide Level 2 inspection.
- E. Where a Quality Assurance Plan is provided as part of the Contract Documents the CONTRACTOR shall provide a written statement of responsibility to the building official and to the OWNER prior to the commencement of work on the system(s) of component(s) so designated within the Quality Assurance Plan. The CONTRACTOR shall acknowledge: awareness of the special requirements contained in the quality assurance plan, control will be exercised to obtain conformance with the construction documents approved by the building official. Also included shall be procedures for exercising control within the CONTRACTOR'S organization, the method and frequency of reporting and the distribution of reports and identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- F. Environmental – The cold weather construction provisions of ACI 530.1/ASCE6/TMS 602, Article 1.8 C shall be implemented when the ambient temperature falls below 40 degrees F or the temperature of the masonry units is below 40 degrees F. The hot weather construction provisions of ACI 530.1/ASCE 6/TMS 602, Article 1.D shall be implemented when the ambient temperature exceeds 100 degrees F or when the temperature exceeds 90 degrees F and the wind velocity is greater than 8 mph. No salt, anti-freeze chemicals or related materials permitted. Store masonry units and bagged materials off ground and protect from rain. Do not build on work having film of water or frost on surfaces. Protect work by covering in rainy weather; protect green masonry from freezing. Before stopping work for day, cover tops of walls at new work with non-staining waterproof covering extended 2 feet minimum down both sides of wall and secured.

PART 2 PRODUCTS

2.1 MORTAR AND GROUT MATERIALS

- A. Cement shall be Type I Portland cement conforming to ASTM C150.
- B. Fine and coarse aggregate shall meet ASTM C404 for grout. Sand shall be clean, sharp, well graded and free from salt, loam, clay and other foreign matter. Sand shall conform to ASTM C144 for mortar. Sand shall be graded as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
4	100
8	95 - 100
16	70 - 100
30	40 - 75
50	15 - 35
100	2 - 15
200	0

- C. Lime shall be hydrated type conforming to ASTM C207, Type S.
- D. Water shall be clean, fit for drinking (potable), and free from strong acids, alkalis, oils or organic material.
- E. Waterproofing admixture shall be powder. Type: Grace Hydratite Plus, CemMaster Hydrolox 400, BASF Rheomix, BASF Rheopel or approved equal.
- F. Accelerator or retardant may be added when required by weather conditions. Type: Anti-Hydro, Grace Dehydratine 80 or Dehydratine 80M, BASF Pozzoloth, Sika Plastiment, Sonneborn Sonotard, Trimex, or approved equal.
- G. Intrusion (water-reducing) admixture for grout. Type: BASF Pozzoloth, IntrusionAid or approved equal.
- H. Water-reducing admixture for mortar. Type: BASF Rheomix or approved equal.
- I. Mortar Color. Pure natural finely milled inert water insoluble non-bleeding and free of deleterious fillers or extenders. Color shall be as shown on the plans. Color shall be selected by OWNER from manufacturer's standard range of colors.

2.2 PROPORTION OF MIXES

- A. Mortar shall conform to ASTM C270 and be of the type and color specified. Mortar shall be Type S and shall have a minimum 28-day compressive strength of 2,000 psi

minimum. Mortar shall be mixed by volume in ratio of 1-part Portland cement (6 sacks per cubic yard minimum), 1/4 to 1/2 part lime, 2¼ to three (3) parts (to cement-lime combined volume) sand. Pointing mortar shall be one part cement, 1/4 lime, three (3) parts sand by volume. Add one (1) pound of water-reducing admix for mortar per bag of cement and one pound per cubic foot of lime. Add waterproofing in amounts recommended by manufacturer, 0.2 pounds of waterproofing per 100 pounds of cement minimum. Do not use admixtures containing more than 0.2 percent chloride ions. Limit the maximum percentage of mineral oxide or carbon black job site pigments by weight of cement as follows: For pigmented Portland cement-lime mortar; 10 percent maximum mineral oxide pigment or 2 percent maximum carbon black pigment.

- B. Masonry grout shall conform to ASTM C476. It shall have a minimum 28 days compressive strength greater than or equal to f'm, but not less than 2,000 psi, seven (7) sacks of cement minimum per cubic yard, and include waterproofing admix and intrusion admix in amounts recommended by manufacturer, 0.2 lb. of waterproofing per 100 pounds of cement minimum.
- C. Grout for pouring shall be of fluid consistency, seven (7) to eight (8) inches slump. Accurately mix by volume 1-part Portland cement: two (2) parts minimum to three (3) parts maximum of damp loose sand: two (2) parts maximum of 3/8-inch minus aggregate. For grout spaces less than three (3) inches in any dimension, omit 3/8-inch minus aggregate. Grout for pumping shall be without segregation of the constituent parts and shall be mixed to a consistency that has a slump between eight (8) to eleven (11) inches.
- D. Empty bags for waterproofing and intrusion admixes shall be retained for verification prior to their disposal. Use accelerator or retardant in strict accordance with manufacturer's printed instructions.

2.3 MASONRY CLEANER

Sure Kleen #101 Lime Solvent, or approved equal.

PART 3 EXECUTION

3.1 MIXING

- A. Grout shall be plant batched.
- B. All tools and equipment used in mixing of mortar shall be clean and free of contaminants. Measure materials by volume or equivalent weight, not by shovel. Supply only as much water as necessary to obtain desired workability; required compressive strength must be met. Mix by placing 1/2 of the water and sand in the operating mixer. Then add the cement, lime and the remainder of the sand and water. After all ingredients are in the batch mixer they shall be mechanically mixed for not less than three (3) minutes. Hand mixing shall not be employed. Heat aggregates when air temperature is below 32 degrees F to maintain mortar at 70 to 120 degrees F until used.
- C. Maintain workability of mortar by retempering. Retemper by adding only as much water as required to maintain high plasticity. Retempering shall only be done by adding water within a basin formed from mortar on a mortar board and working mortar into water. Discard all mortar which has begun to stiffen, or which is unused after 2-1/2 hours from the initial mixing.

3.2 INSTALLATION

- A. All masonry shall be laid true straight level, plumb and neatly in accordance with the drawings; lay out in advance so that no concrete unit less than eight (8) inches in length occur except where necessary as in reveals, etc. All units shall be laid in running bond.
- B. All units shall be saw cut accurately to fit all openings, and for electrical and plumbing work. No plumbing or electrical boxes or conduit shall be placed in any cell or course that contains reinforcing. All cutting shall be done with masonry saw and produce neat and true surface. All units shall be sound, dry, clean and free from cracks and chips.
- C. No construction supports shall be attached to the wall except where specifically permitted.
- D. Units shall be "air" dry at time of laying.

3.3 REINFORCEMENT (SEE ALSO SECTION 03 10 00)

- A. Before placing reinforcement remove mud, oil, mill scale, loose rust, ice and any other coatings from it. Position reinforcement accurately; center in cells unless noted otherwise. Secure against displacement, holding vertical reinforcement firmly in place by means of frames, rebar spacers, or other suitable devices, and place horizontal reinforcement as laying progresses. Vertical bars shall be held in position at the top and bottom and at intervals not exceeding 192 diameters of the reinforcement.
- B. Minimum clear distance between longitudinal bars shall be nominal diameter of bar or 1-inch, whichever is larger. Minimum thickness of mortar or grout between masonry and reinforcement shall be 1/4-inch for fine grout and 1/2-inch for coarse grout. Unless noted otherwise, reinforcing bars and dowels shall be lapped 40 bar diameters or 2-foot six (6) inches minimum, where spliced end shall be separated by 1 bar diameter or wired together.
- C. Splice reinforcement only at points shown on drawings or reviewed shop drawings; any other locations must be specifically reviewed. Splices in adjacent bars shall be staggered; in horizontal reinforcement of walls separate at least 10 feet longitudinally for bars of same tier.
- D. When a foundation dowel does not line up with a vertical core, it shall not be sloped more than one horizontal in six vertical. Dowel shall be grouted into a core in vertical alignment, even though it may be in cell adjacent to cell holding vertical wall reinforcing.
- E. Bond beam reinforcement shall be laid continuously on webs of bond beam units. Intersecting masonry walls shall be tied to one another by horizontal reinforcement, unless noted otherwise; where masonry walls intersect with concrete walls, connect with 1/2-inch diameter by 15-inch mechanical bolts in flush shells at bond beams.
- F. To allow bonding masonry, clean laitance from top of concrete foundation before proceeding. The staining joint on foundations or slabs shall be laid with full mortar coverage except at the area where grout occurs, which shall be kept free of mortar so that grout is in contact with the foundation slabs.
- G. Lay units in regular running bond. Corners shall have same masonry bond by overlapping units. Joints shall be uniform throughout all work having same type of masonry units.
- H. At running bond, thread vertical reinforcing through alternately overlapping cells. Lay units according to "face and shell" method; provide full mortar coverage on all face

shells, and on faces and webs surrounding vertical and horizontal cells to be filled with grout.

- I. Do not furrow bed joints. Shove tightly each new unit against existing unit so that mortar bonds well to both.
- J. Rock closures into place. Do not pound corners and jambs to fit stretcher units after they are set in position. Remove all excess grout and mortar spilled on masonry units during construction.
- K. Dry brush all masonry surfaces at end of each day's work. Stop off horizontal run of masonry by racking back one half length of unit in each course at end of day's work. Tooothing is not permitted. Where fresh masonry joins partially set masonry, remove loose units and mortar clean and then lightly wet exposed surface of set masonry before starting new work.
- L. Joints of walls to be covered or furred may be left flush, without tooling. Joints of all walls which are to be exposed shall be tooled when "thumb right" hard mortar is partially set but still sufficiently plastic to bond) with round jointer or bar to produce a dense, slightly concave surface, well bonded at edges. All tooling shall be done with a tool which compacts the excess mortar out of joint rather than dragging it out. Joints which are not tight at the time of tooling shall be raked out, pointed, and then tooled. If it is necessary to move to a unit after it has been once set in place, the unit shall be removed from wall, cleaned and set in fresh mortar. Remove any mortar fins from joint junctions.
- M. Forms and shores for lintels shall be substantial. Brace or tie forms to maintain position and shape. Forms shall be tight with no leakage of mortar or grout. Do not remove forms and shores until masonry has hardened sufficiently to carry its own weight and other temporary loads that may be placed on it during construction, 10 days minimum.

3.4 GROUTING

- A. Grouting shall be by low lift method.
- B. Cells containing reinforcement or embedded items shall be solidly filled with grout. Before grouting starts, reinforcing steel shall be secured in a place and inspected by both the special inspector and Building Inspector from governmental unit having authority.
- C. Vertical cells to be filled shall have vertical alignment to maintain continuous unobstructed cell area. To confine grout to horizontal masonry beams, the tops of

unfilled cell cavities or cores in masonry units under beams shall be covered with metal lath, or special bond beam or lintel units shall be used, or another method may be employed if approved, building paper shall not be permitted.

- D. All bolts, anchors, etc., inserted in walls shall be fully and solidly grouted in place. Embedment shall not be less than 3/4 of the wall thickness, unless otherwise noted.
- E. Masonry shall cure at least 24 hours before grouting. Keep clean of mortar and drippings those cavities and cores which are to be grouted. Mortar projections and droppings shall be washed out of spaces and off reinforcing with a jet stream of water.
- F. Grout shall be poured in lifts not exceeding five (5) feet. All masonry shall be laid using the Low-Lift grouting method with maximum grout pour heights not to exceed five (5) feet. In addition, grout pour heights shall not exceed the maximum grout pour height limits of ACI 530.1/ASCE6/TMS 602, based upon the minimum grout space dimensions for grouting of cells of hollow units. Lay masonry until location of a bond beam or horizontal lintel beam is reached, but not to exceed the limits of ACI 530.1/ASCE6/TMS 602, and then grout full the vertical cells required to be grouted and fill the beam or lintel without pause.
- G. To insure complete filling of grout space, consolidate grout at time of pouring by puddling and then reconsolidate by later puddling before the plasticity is lost. Consolidate pours exceeding 12 inches in height by mechanical vibration and reconsolidate by mechanical vibration after initial water loss and settlement has occurred.
- H. Provide cleanouts in the bottom course of masonry for each grout pour exceeding 5 feet. Cleanouts are required at 32" o.c. maximum.
- I. Solid grout hollow metal door and window frames; for all wall openings over two (2) feet wide, solid grout from lintel to floor or roof above in one continuous operation.
- J. Place grout within 1 1/2 hour from introducing water in the mixture and prior to initial set.

3.5 MASONRY CLEANING

- A. All mortar and grout must be thoroughly set and cured before cleaning. Remove excess mortar or mortar stains or efflorescence; scraping devices shall be nonferrous. Protect all adjacent surfaces, including sash and other corrodible metal-work, from damage by cleaning solvent.

- B. Saturate all exposed masonry with water immediately before cleaning, apply solution of cleaner as per manufacturer's instructions and rinse thoroughly with fresh, clean water immediately after cleaning. Do small sections at a time, working from top to bottom. Repeat as necessary.
- C. Tuckpoint any loose or defective mortar joints. At conclusion of masonry work, remove scaffolding and equipment used in work and remove debris, refuse and surplus masonry material.

END OF SECTION

SECTION 04 22 00
CONCRETE UNIT MASONRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Concrete masonry units.
 - 2. Decorative concrete masonry units
 - 3. Steel reinforcing bars.
 - 4. Masonry joint reinforcement.
 - 5. Ties and anchors.
 - 6. Embedded flashing.
 - 7. Miscellaneous masonry accessories.

1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide structural unit masonry that develops 2000 PSI net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to ACI 530.1/ASCE 6/TMS 602.

2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For the following:
 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Verification: For each type and color of the following:
 1. CMUs.
 2. Pigmented and colored-aggregate mortar. Make Samples using same sand and mortar ingredients to be used on Project.
 3. Accessories embedded in masonry.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: For each type and size of the following:
 1. Masonry units.
 - a. Include material test reports substantiating compliance with requirements.
 - b. For masonry units, include data and calculations establishing average net-area compressive strength of units.
 2. Cementitious materials. Include brand, type, and name of manufacturer.
 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 4. Reinforcing bars.

5. Joint reinforcement.
 6. Anchors, ties, and metal accessories.
- C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according ACI 530.1/ASCE 6/TMS 602.
 - D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.
- B. Source Limitations for Masonry Units: Obtain all masonry units from single source from single manufacturer.
- C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 PRODUCTS

2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - 2. Provide square-edged units for outside corners unless otherwise indicated.
- B. CMUs: ASTM C 90.
 - 1. Density Classification: Medium weight.
 - 2. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.
 - 3. Exposed Faces: Refer to construction documents.
- C. Decorative CMUs: ASTM C 90.
 - 1. Density Classification: Medium weight.
 - 2. Size (Width): Manufactured to dimensions specified in "CMUs" Paragraph.
 - 3. Pattern and Texture:
 - a. Standard pattern, split-face finish. Refer to elevations shown on plan.
 - b. Scored vertically so units laid in running bond appear as square units laid in stacked bond (single score), ground-face finish.
 - c. Pattern, texture and color locations: Locations of various patterns, textures and colors are indicated on the plans and designated in the color schedule.

2.3 MASONRY LINTELS

- A. General: Provide one of the following:
- B. Masonry Lintels: Built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

2.4 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M, Grade 60.

2.5 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.
 - 1. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
 - 2. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
 - 4. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.
- B. Adjustable anchors for connecting to existing CMU walls: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 - 1. Corrugated Metal Ties: Metal strips not less than 7/8 inch (22 mm) wide with corrugations having a wavelength of 0.3 to 0.5 inch (7.6 to 12.7 mm) and an amplitude of 0.06 to 0.10 inch (1.5 to 2.5 mm) made from 0.109-inch- (2.78-mm-) thick, stainless-steel sheet and sized to extend to within 1 inch (25 mm) of masonry face. Anchors shall be spaced as to support not more than 2 square feet of wall area, and 24" o.c. maximum.

2.6 MISCELLANEOUS ANCHORS

- A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers. Bolts, nuts, and washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C.
- B. Post-installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 2. Materials: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches (76 mm) into wall with hemmed inner edge to receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.
7. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees and hemmed.
8. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches (76 mm) into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch (19 mm) and down into joint 1/4 inch (6 mm) to form a stop for retaining sealant backer rod.
9. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Flexible Flashing: Use the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

- a. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
- C. Application: Unless otherwise indicated, use the following:
 - 1. Where flashing is indicated to receive counterflashing, use metal flashing.
 - 2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
 - 3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
 - 4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Solder and Sealants for Sheet Metal Flashings:
 - 1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.
 - 2. Elastomeric Sealant: ASTM C 920, chemically curing silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.
- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch (3 mm) less than depth of outer wythe; in color selected from manufacturer's standard.
 - a. 1375: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
- E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mortar Net USA, Ltd.; Mortar Net.
 2. Provide the following configurations:
 - a. Strips, full-depth of cavity and 10 inches (250 mm) high, with dovetail shaped notches 7 inches (175 mm) deep that prevent clogging with mortar droppings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.

- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units to provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
 2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.

3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
 4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
 - C. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.6 CONTROL AND EXPANSION JOINTS

- A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

3.7 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

3.8 FLASHING

- A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
 2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.

3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
 4. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant.
 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall and adhere flexible flashing to top of metal drip edge.
- C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

3.9 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms 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 loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 and Level 2 special inspections according to the construction documents.

- C. Testing Prior to Construction.

3.11 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Owner's Representative approval of sample cleaning before proceeding with cleaning of masonry.
 3. Protect adjacent nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.

END OF SECTION

DIVISION 05 - METALS

SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 Summary

A. Section Includes:

1. Structural steel work as defined in AISC Code of Standard Practice.
2. Anchor bolts required for installation in other work.

1.2 Submittals

A. Product Data: Manufacturer's data sheets or specifications and installation instructions, including laboratory test reports and other data to show compliance with specifications and specified standards.

1. Anchor bolts and threaded rods, including nuts and washers.
2. Structural steel primer, paint, galvanizing compound.

B. Shop Drawings: Include complete details and schedules for fabrication, assembly and erection. Provide setting drawings, templates, and directions for installation of anchor bolts and other anchorages.

C. Certificates: Provide certification that welders have satisfactorily passed AWS and WABO qualification tests and that certification is current.

1.3 Quality Assurance

A. Codes and Standards: Comply with applicable provisions except as otherwise indicated:

1. AISC, Code of Standard Practice for Steel Buildings and Bridges.
2. AISC, Specification for Structural Steel Buildings, including Commentary.
3. American Welding Society (AWS) D1.1 Structural Welding Code Steel.

B. Quality Control: Perform inspection of bolting and welding.

C. Report inspection results in writing within 24 hours.

- D. CONTRACTOR shall develop and implement a Quality Assurance Plan that describes work procedures and requirements, identifies reference documents and codes, establishes responsibility for quality control, describes record keeping requirements, and outlines inspection and documentation requirements. The CONTRACTOR is not required to submit the Quality Assurance Plan for review but is advised that all work shall conform to the plan.

PART 2 PRODUCTS

2.1 Materials

- A. General: Refer to the General Structural Notes in the S-series Drawings for more information.
- B. Specifications for the following materials are included in the General Structural Notes in the Drawings:
 - 1. Structural steel.
 - 2. Connection material.
 - 3. Anchor bolts.
 - 4. Threaded rods.
 - 5. Welding electrodes.
 - 6. Structural bolts.
- C. Shop Primer Paint: Tnemec 90-93 Tneme-Zinc; or SSPC-PS 12.01 (SSPC-Paint 20, Type II); and meeting following requirements:
 - 1. Suitable for use without topcoating.
 - 2. Recommended by finish coating manufacturer to be part of finish system.
 - 3. Manufacturer's standard color as suitable for use under finish coating system materials.
- D. Electrodes for Welding: Comply with AWS code and structural drawings.

PART 3 EXECUTION

3.1 Fabrication

- A. Shop Fabrication and Assembly: Fabricate and assemble structural assemblies in shop to greatest extent possible. Fabricate items in accordance with AISC Specifications and final shop drawings.
 - 1. Mark and match-mark units for field assembly.
 - 2. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
 - 3. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
 - 4. Where finishing is required, complete assembly, including welding of units, before start of finishing operations.
- B. Connections: As shown on Drawings. Comply with AWS Code for procedures, appearance, and quality of welds.
- C. Provisions for Other Work: Fabricate structural steel members to provide holes for securing other work and for passage of other work through steel framing. Holes not shown on the Drawings shall be submitted for approval prior to fabrication.
- D. Exposed Structural Steel: Fabricate surfaces indicated as FINISHED to have maximum ANSI roughness height value of 500.
 - 1. Dress sharp edges and projections.
 - 2. Make exposed joints butt tight, flush, and hairline.
 - 3. Grind fillet welds smooth.
 - 4. Grind butt welds flush with adjacent surfaces.

3.2 Shop Painting

- A. Paint structural steel work, except members or portions of members to be, galvanized, or embedded in concrete or mortar or surfaces designed as part of a composite steel-concrete section.
 - 1. Do not paint contact areas to be welded or contact surfaces of friction type connections.

2. Do not paint interior steel surfaces to receive sprayed-on fireproofing. Provide free of primer and paint.
- B. Clean steel free of loose mill scale, loose rust, and spatter, slag, and flux deposits.
 - C. Remove oil and grease deposits in accordance with SSPC SP-1, Solvent Cleaning.
 - D. Immediately after cleaning surface, apply shop primer paint in accordance with manufacturer's instructions and at a rate to provide minimum dry film thickness of not less than 2.0 mils (50 microns).
 - E. All structural steel that is exposed to weather or in contact with pressure treated wood shall be hot-dip galvanized, unless noted otherwise.

3.3 Erection

- A. Comply with AISC Code and AISC Specification, and maintain work in safe and stable condition during erection.
- B. Provide temporary bracing and shoring as required; remove when final connections are placed.
- C. Splice members only where shown on final shop drawings.

3.4 Cleaning

Touch up prime paint after erection.

1. Clean field welds, bolted connections and abraded areas.
2. Apply same type paint as used in shop.

END OF SECTION

SECTION 05 50 00

METAL FABRICATIONS

PART 1 GENERAL

1.1 DESCRIPTION OF WORK

This Section covers all miscellaneous iron, steel, aluminum or other non-ferrous metal work, not specifically described in other sections.

1.2 SUBMITTALS

- A. Complete detail drawings of all steel and miscellaneous metal items specified herein or shown on the plans.
- B. Certification of conformance with ASTM A380 and these specifications for handling, cleaning, descaling, and passivation of stainless steel.
- C. Material data and certification for steels and weld electrodes.
- D. Submit welding procedure specifications (WPS) for all welds to be used in the work. WPS shall conform to AWS D1.1, D1.2, or D1.6 as applicable, and to AWS B2.1 "Specification for Welding Procedure and Performance Qualification."
- E. Submit documentation of qualifications and current welding certification for all welders indicating qualifications for welding of steel, aluminum, or stainless steel as applicable.

1.3 STANDARDS AND CODES

- A. American Institute of Steel Construction, "Manual of Steel Construction", latest edition.
- B. "The Design and Fabrication of Galvanized Products," Zinc Institute.
- C. AWS Standard D1.1 "Structural Welding Code - Steel," latest edition.
- D. AWS Standard D1.2 "Structural Welding Code - Aluminum," latest edition.
- E. AWS Standard D1.6 "Structural Welding Code – Stainless Steel," latest edition.
- F. ASTM A380 "Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems."
- G. ANSI/NAAMM MBG 531 "Metal Bar Grating Manual."

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

- A. STRUCTURAL STEEL: ASTM A992, 50 ksi (rolled shapes), ASTM A500 (tubing), ASTM A53, Grade B (pipe), ASTM A6 (general requirements), A36 (channels and angles).
- B. MISCELLANEOUS STEEL: "Merchant" quality.
- C. ALUMINUM: ASTM B221, type 6061 or 6063.
- D. STAINLESS STEEL: ASTM A666, type 316. Use 316L for shapes to be welded. Filler metals for welding shall be matching metal as specified in ANSI/AWS A5.9 Specification for Corrosion-Resisting Chromium and Chromium-Nickel Steel Bare and Composite Metal Cored and Stranded Welding Electrodes and Welding Rods. Minimum 70 ksi tensile strength.
- E. BOLTS AND NUTS: Bolts and Nuts shall meet the requirements of the following specifications:
 - 1. Anchor bolts: For equipment anchorage, drilled anchors shall either be epoxy adhesive type or expansion type, torque-controlled, 316 stainless steel, Hilti, or approved equal ASTM A307. Cast-in-place anchor bolts for attachment of wood nailers shall be galvanized ASTM A307, unless otherwise indicated on the Drawings.
 - 2. Expansion bolts: Bolts, nuts and washers shall be 316 stainless steel; wedges shall be double plated spring steel.
 - 3. Machine bolts: Stainless steel where called out on the drawings or specified. All carbon steel bolts, nuts and washers shall be hot dip galvanized for fabrication of galvanized metals. Unless noted otherwise, stainless steel shall be used.
 - 4. High-strength bolts: ASTM A325 hot-dip galvanized, or stainless steel where called out on the drawings. Unless noted otherwise, stainless steel shall be used.

2.2 FABRICATION

- A. FABRICATION
 - 1. Workmanship: Conform to accepted shop practices. Form work true to detail, with clean, straight, sharply defined profiles. Unless otherwise shown or specified, finish exposed welds flush and smooth.
 - 2. Joints and Connections: Weld all joints, unless other fastening methods are shown, specified, or specifically approved. Close fit exposed joints; make joints where least

conspicuous. Unless otherwise shown or specified, use flat and countersunk headed bolts or screws in exposed connections.

3. Cutting, Drilling: Perform coping, cutting, drilling and punching required for accurate fitting and assembly work. In addition, perform similar operations as required for attachment of work of other trades, provided that directions for such work are supplied prior to project data approval. Where galvanized assemblies, punched holes shall be reamed; use flame cutting rather than cold shearing; avoid cold forming to prevent galvanizing vent holes in closed assemblies in accordance with Zinc Institute recommendations.
4. Provisions for Attachment to Structure: Furnish miscellaneous metal items complete with framing, supports, hangers, bracing, anchors and other devices shown, specified or necessary for reinforcement and proper, secure setting or attachment.
5. Dissimilar Materials Protection: Insulate aluminum surfaces in contact with metals other than galvanized or stainless steel, or with plaster or concrete by means of chromate gasketing or heavy coat of alkali-resistant bituminous paint.
6. Workmanship: Fabricate all items neatly and rigidly in accordance with the details. Form curved metal neatly to radii indicated. Provide members of sizes indicated and weld, bolt or rivet securely together. Furnish bolts, nuts, washers, and other fastening devices required for anchoring and securing work.
7. Welding: Use electric shielded-arc process in accordance with Welding Specifications of American Welding Society. Use only welding operators properly trained, highly skilled, and AWS-certified in arc welding. All welding shall be performed by Washington Association of Building Officials (WABO) certified welders. Grind smooth all surface welds exposed to view.

B. SPECIAL REQUIREMENTS FOR STAINLESS STEEL FABRICATIONS

1. Due to the highly corrosive environments in which some of the stainless steel fabrications may be used, particularly the mixing and diversion structures, careful handling of stainless steel during fabrication, handling, storage, and installation shall be observed at all times to prevent potential contamination of the stainless steel with carbon steel or other materials which may reduce the corrosion resistance of the stainless steel.
2. Cleaning, descaling, and passivation of stainless steel fabrications shall conform to the recommendations and requirements of ASTM A380, including the following steps:

- a. Preclean all metal surfaces prior to fabrication, and descale using ASTM A380, Annex A1, Code A.
 - b. Clean weld areas prior to welding in accordance with ASTM A380 section 6.3.
 - c. Passivate fabricated assembly after welding using ASTM A380, Annex A2, Code F, followed by rinsing several times with hot water and drying after the final rinse.
3. All welding of stainless steel shall conform to AWS D1.6 and approved welding procedure specifications.
 4. Provide a light pressure wash with clean water at the job site prior to installation of fabricated stainless steel items.

2.3 HOT-DIP GALVANIZING

Steel items called out on the drawings or specified herein as galvanized, shall be hot-dip coated in accordance with one or more of the following, as is applicable:

Reference	Title
ASTM A90/A90M	Standard Test Methods for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A123/A123M	Zinc Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip
ASTM A143	Recommended Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products for Detecting Embrittlement
ASTM A153/A152M	Zinc Coating on Iron and Steel Hardware
ASTM A384/A384M	Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies
ASTM A385	Providing High Quality Zinc Coatings on Assembled Products

PART 3 EXECUTION

3.1 INSTALLATION

- A. GENERAL: Install work in strict accordance with drawings. Perform cutting, drilling and fitting required. Accurately set, place and properly, securely attach work in true plans, alignment, plumb and level; properly adequately reinforce and stiffen.
- B. PRIME COAT TOUCHUP: After installation of steel items, touch up field bolts, field welds, uncoated connections, and abrasions to shop protective coatings. Clean items of mud, dirt and other objectionable foreign matter prior to touching up the prime coat and field painting.
- C. GALVANIZED ITEMS: Items that have been drilled, cut, welded, or otherwise damaged shall be touched up using either of the following products:

1. "Galv-Weld," manufactured by Kenco Division of Southern Coating and Chemical Co., Galv-Weld Products, Sumter, South Carolina. Apply in accordance with manufacturer's instructions and to same thickness as specified hot dip coating.
 2. Hot stick followed by CRC Zinc Re-nu brush-on cold galvanizing compound with epoxy binder. Apply in accordance with manufacturer's instructions.
- D. ALUMINUM ITEMS: Aluminum items in contact with concrete shall have contact surfaces coated to prevent corrosion. Aluminum items in contact with steel shall be electrically isolated with gaskets and fastener sleeves.

END OF SECTION

DIVISION 06 – WOOD AND PLASTICS

SECTION 06 05 00

FASTENERS AND ADHESIVES

PART 1 GENERAL

1.1 DESCRIPTION

This Section specifies the requirements for fasteners and adhesives used in the construction.

PART 2 PRODUCTS

2.1 ROUGH CARPENTRY HARDWARE

Rough carpentry hardware used in building construction shall conform to the latest provisions of the Washington State Building Code, the International Building Code (IBC), and to any local codes and ordinances.

2.2 NAILS

Steel common nails for framing, appropriately sized for the materials being joined. Use hot dipped galvanized nails wherever exposed. Use stainless steel nails at locations where stainless steel hardware is specified in the Contract Documents, do not mix dissimilar materials without approval. Hot-dipped galvanized or stainless steel nails are required at all locations where they are in contact with treated wood. The number and size of nails connecting wood members shall be per the Contract Documents.

2.3 BOLTS AND SCREWS

Conforming to ASTM A307, appropriately sized for the materials being joined. Use galvanized bolts and screws where exposed or in contact with treated wood or embedded into concrete or masonry. Stainless steel required where exposed to weather.

2.4 FRAMING ANCHORS, JOIST, RAFTER AND BEAM HANGERS

Use galvanized minimum 18-gauge steel of the size and type required for the materials connected. Simpson "Strong-Tie," Teco "Lumber Lok," Silver Metal Products, or approved equal. Post hot-dip galvanize all connection hardware in contact with pressure treated wood, or use stainless steel connectors.

2.5 ADHESIVES

Use gun grade adhesive suitable for bonding various metals and non-metallic materials such as wood, plastic and glass without primer. Submit manufacturer's data for approval.

PART 3 EXECUTION

3.1 GENERAL

Use only skilled workers and the highest standards of the craft. Lay out, cut, fit, and install all rough carpentry items. Anchor sufficiently to ensure rigidity and permanence as noted on the plans.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Framing with dimension lumber.
 2. Framing with engineered wood products.
 3. Rooftop equipment bases and support curbs.
 4. Wood blocking, cants, and nailers.
 5. Wood furring.
 6. Plywood backing panels.

1.2 DEFINITIONS

- A. Exposed Framing: Framing not concealed by other construction.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NLGA: National Lumber Grades Authority.
 2. WCLIB: West Coast Lumber Inspection Bureau.
 3. WWPA: Western Wood Products Association.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 1. Wood-preservative-treated wood.
 2. Engineered wood products.
 3. Power-driven fasteners.
 4. Powder-actuated fasteners.
 5. Expansion anchors.
 6. Metal framing anchors.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by

an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.
- C. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWWA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, roofing vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood framing and furring that is exposed to exterior conditions.

2.3 DIMENSION LUMBER FRAMING

- A. Wall studs: As indicated; minimum Hem-fir stud grade.
- B. Joists, Rafters, and Other Framing: As indicated; minimum No. 2 grade and of the following species:
 1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Hem-fir; WCLIB or WWPA.

2.4 ENGINEERED WOOD PRODUCTS

- A. Engineered Wood Products, General: Products shall contain no urea formaldehyde.
- B. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.
- C. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Boise Cascade Corporation.

- b. Georgia-Pacific.
 - c. Roseburg Forest Products Co.
 - d. Weyerhaeuser Company.
- 2. Extreme Fiber Stress in Bending: 2,600 psi for 12-inch nominal depth members.
 - 3. Modulus of Elasticity: 1,900,000 psi.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including but not limited to the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
- B. For items of dimension lumber size, provide No. 2 and any of the following species:
 - 1. Hem-fir; WCLIB or WWPA.
 - 2. Douglas fir-larch; WCLIB or WWPA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
 - 1. Hem-fir; Construction or No. 2 Common grade; WCLIB, or WWPA.
 - 2. Douglas fir-larch; Construction or No. 2 Common grade; WCLIB, or WWPA.
- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.6 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- F. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers. Interior bolts, nuts, and washers in contact with concrete, masonry, or pressure treated wood, hot-dip galvanized to comply with ASTM A 153/A 153M, Class C.
- G. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - 1. Materials: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

2.7 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. KC Metals Products, Inc.
 - 3. Phoenix Metal Products, Inc.
 - 4. Simpson Strong-Tie Co., Inc.
 - 5. USP Structural Connectors.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published

values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 - 1. Use for interior locations unless otherwise indicated.
- D. Stainless-Steel Sheet: ASTM A 666, Type 304.
 - 1. Use for exterior locations, and where indicated.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

- F. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- G. Do not splice structural members between supports unless otherwise indicated.
- H. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches (406 mm) o.c.
- I. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches (2438 mm) o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches (2438 mm) o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- (38-mm actual-) thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. (9.3 sq. m) and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet (6 m) o.c.
- J. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- K. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.

- L. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- M. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal- (19-by-38-mm actual-) size furring vertically at 16 inches (406 mm) o.c.

3.4 CEILING JOIST AND RAFTER FRAMING INSTALLATION

- A. Ceiling Joists: Install ceiling joists with crown edge up and complying with requirements specified above for floor joists. Face nail to ends of parallel rafters.
 - 1. Where ceiling joists are at right angles to rafters, provide additional short joists parallel to rafters from wall plate to first joist; nail to ends of rafters and to top plate and nail to first joist or anchor with framing anchors or metal straps. Provide 1-by-8-inch nominal- (19-by-184-mm actual-) size or 2-by-4-inch nominal- (38-by-89-mm actual-) size stringers spaced 48 inches (1200 mm) o.c. crosswise over main ceiling joists.

- B. Rafters: Notch to fit exterior wall plates and use metal framing anchors. Double rafters to form headers and trimmers at openings in roof framing, if any, and support with metal hangers. Where rafters abut at ridge, place directly opposite each other and nail to ridge member or use metal ridge hangers.
 - 1. At valleys, provide double-valley rafters of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against valley rafters.
 - 2. At hips, provide hip rafter of size indicated or, if not indicated, of same thickness as regular rafters and 2 inches (50 mm) deeper. Bevel ends of jack rafters for full bearing against hip rafter.
- C. Provide special framing as indicated for eaves, overhangs, dormers, and similar conditions if any.

3.8 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes sufficiently wet that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 06 16 00

SHEATHING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof sheathing.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 WOOD PANEL PRODUCTS

- A. Plywood: DOC PS 2 unless otherwise indicated.
- B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated on plans.
- C. Factory mark panels to indicate compliance with applicable standard.

2.2 ROOF SHEATHING

- A. Plywood: DOC PS 1, Exposure 1, C-D exposure 1 sheathing with exterior glue.
 - 1. Span Rating: As indicated on plans.
 - 2. Nominal Thickness: As indicated on plans.
 - 3. Orientation: As indicated on plans.
 - 4. Nailing: As indicated on plans.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements as specified.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.

2.4 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.
 - 1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

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

- F. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- G. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

- A. GENERAL: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. FASTENING METHODS: Fasten panels as indicated below:
 - 1. Roof Sheathing:
 - a. Glue and nail to wood framing.
 - b. Space panels 1/8 inch (3 mm) apart at edges and ends.

END OF SECTION

SECTION 06 18 00

GLUED-LAMINATED CONSTRUCTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 SUMMARY

- A. Section includes framing using structural glued-laminated timber.

1.3 DEFINITIONS

- A. Structural Glued-Laminated (Glulam) Timber: An engineered, stress-rated timber product assembled from selected and prepared wood laminations bonded together with adhesives and with the grain of the laminations approximately parallel longitudinally.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include data on lumber, adhesives, fabrication, and protection.
 - 2. For connectors: Include installation instructions.
- B. Shop Drawings:
 - 1. Show layout of structural glued-laminated timber system and full dimensions of each member.
 - 2. Indicate species and laminating combination.
 - 3. Include large-scale details of connections.

1.5 INFORMATIONAL SUBMITTALS

- A. Certificates of Conformance: Issued by a qualified testing and inspecting agency indicating that structural glued-laminated timber complies with requirements in AITC A190.1.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111.
- B. Individually wrap members using plastic-coated paper covering with water resistant seams.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Structural glued-laminated timber and connectors shall withstand the effects of structural loads shown on Drawings without exceeding allowable design working stresses listed in AITC 117 or determined according to ASTM D 3737 and acceptable to authorities having jurisdiction.
- B. Seismic Performance: Structural glued-laminated timber and connectors shall withstand the effects of earthquake motions determined according to the local applicable building codes.

2.2 STRUCTURAL GLUED-LAMINATED TIMBER

- A. General: Provide structural glued-laminated timber that complies with AITC A190.1 and AITC 117 or research/evaluation reports acceptable to authorities having jurisdiction. Exterior exposed beams shall be pressure treated for use in exterior environments.
 - 1. Factory mark each piece of structural glued-laminated timber with AITC Quality Mark or APA-EWS trademark. Place mark on surfaces that are not exposed in the completed Work.
 - 2. Provide structural glued-laminated timber made from solid lumber laminations; do not use laminated veneer lumber.
 - 3. Adhesive shall not contain urea-formaldehyde resins.
- B. Species and Grades for Structural Glued-Laminated Timber: Douglas fir-larch that meets or exceeds structural properties of 24F-V8 complying with the National Design Specifications for Wood Construction (NDS), latest edition.
- C. Appearance Grade: Architectural, complying with AITC 110.

2.3 TIMBER CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Cleveland Steel Specialty Co.
 - 2. Simpson Strong-Tie Co., Inc.
 - 3. USP Structural Connectors.

2.4 MISCELLANEOUS MATERIALS

- A. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
- B. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.

2.5 FABRICATION

- A. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
 - 1. Dress exposed surfaces as needed to remove planing and surfacing marks.
- B. Camber: None.
- C. End-Cut Sealing: Immediately after end cutting each member to final length, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood coated for not less than 10 minutes.
- D. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.

2.6 FACTORY FINISHING

- A. Clear Finish: Manufacturer's standard, two-coat, clear varnish finish; resistant to mildew and fungus.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates in areas to receive structural glued-laminated timber, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Erect structural glued-laminated timber true and plumb and with uniform, close-fitting joints. Provide temporary bracing to maintain lines and levels until permanent supporting members are in place.
 - 1. Handle and temporarily support glued-laminated timber to prevent surface damage, compression, and other effects that might interfere with indicated finish.
- B. Framing Built into Masonry: Provide 1/2-inch (13-mm) clearance at tops, sides, and ends of members built into masonry.
- C. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
- D. Fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
 - 1. Predrill for fasteners using timber connectors as templates.
 - 2. Finish exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
 - 3. Coat cross cuts with end sealer.
- E. Install timber connectors as indicated.
 - 1. Unless otherwise indicated, install bolts with same orientation within each connection and in similar connections.
 - 2. Install bolts with orientation as indicated.

3.3 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Owner's Representative.

3.4 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose, including protection from weather, sunlight, soiling, and damage from work of other trades.
 - 1. Coordinate wrapping removal with finishing work. Retain wrapping where it can serve as a painting shield.
 - 2. Slit underside of wrapping to prevent accumulation of moisture inside the wrapping.

END OF SECTION

SECTION 06 61 00

FIBERGLASS REINFORCED PLASTICS (FRP) FABRICATIONS MOLDED GRATING

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. The Contractor shall furnish, modify (where necessary), and install all fiberglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.2 REFERENCES

- A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:

1. ASTM D 635 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
2. ASTM D 732 Shear Strength of Plastics by Punch Tool
3. ASTM E 84 Surface Burning Characteristics of Building Materials
4. NSF/ANSI STANDARD 61

1.3 CONTRACTOR SUBMITTALS

- A. The Contractor shall furnish shop drawings of all fabricated gratings and accessories in accordance with the provisions of this Section.
- B. The Contractor shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.
- C. The Contractor shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the contract documents.

- D. The Contractor may be requested to submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the Work.

1.4 QUALITY ASSURANCE

- A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years' experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.
- B. Manufacturer shall offer a 3-year limited warranty on all FRP products against defects in materials and workmanship.
- C. Manufacturer shall be certified to the ISO 9001-2008 standard.
- D. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or products (DNV, ABS, USCG, AARR).
- E. Manufacturer shall provide proof, via independent testing less than six months old, that materials proposed as a solution do not contain heavy metals in amounts greater than that allowed by current EPA requirements.

1.5 PRODUCT DELIVERY AND STORAGE

- A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.
- B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70- and 85-degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Fibergrate Composite Structures Inc.
- B. National Grating FRP Solutions

- C. Or approved Equal

2.2 GENERAL

- A. All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
- B. Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.
- C. Resin shall be Vinyl Ester or Isophthalic Polyester with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.
- D. All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.
- E. All pultruded structural shapes shall be further protected from ultraviolet (UV) light with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to help produce a resin rich surface.
- F. All fire-retardant molded grating products shall have a tested flame spread rating of 25 or less per ASTM E-84 Tunnel Test. Gratings shall not burn past the 25 mm reference mark and will be classified HB per ASTM D635.
- G. All mechanical grating clips shall be manufactured of Type 316SS (stainless steel).

2.3 MOLDED FRP GRATING

- A. Manufacture: Grating components shall be high strength and high stiffness pultruded elements having a maximum of 70% and a minimum of 60% glass content (by weight) of continuous roving and continuous strand mat fiberglass reinforcements. The finished surface of the product shall be provided with a surfacing veil to provide a resin rich surface which improves corrosion resistance and resistance to ultraviolet degradation. Bearing bars shall be interlocked and epoxied in place with a two piece cross rod system to provide a mechanical and chemical lock. Cross rods should be below the walking surface of the grating. Gratings with cross rods that are flush with the walking surface are excluded.
- B. Non-slip surfacing: Grating shall be provided with a quartz grit bonded and baked to the top surface of the finished grating product.

- C. Grating bar intersections are to be filleted to a minimum radius of 1/16" to eliminate local stress concentrations and the possibility of resin cracking at these locations.
- D. Fire rating: Grating shall be fire retardant with a tested flame spread rating of 25 or less when tested in accordance with ASTM E 84. Manufacturer may be required to provide certification of ASTM E84 test on grating panels from an independent testing laboratory. Test data shall be from full scale testing of actual production grating, of the same type and material supplied on the project. Test data performed only on the base resin shall not be acceptable.
- E. Resin system: The resin system used in the manufacture of the grating shall be VEFR or ISOFR. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating corrosion resistance and shall not be accepted.
- F. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted.
- G. Color: Gray or Yellow
- H. Depth: 2" deep load bars with a tolerance of plus or minus 1/32".
- I. Load/Deflection: Grating design loads shall be less than manufacturers published maximum recommended loads. Maximum recommended loads shall be determined by acoustic emission testing. Grating shall be designed for a uniform load of 125 psf or concentrated load of 300 lb. Live load deflection is not to exceed 0.25" or L/D = 360, whichever is less.
- J. The manufacturer shall certify that the stiffness of all panels manufactured are never more than 2.5% below the published load-deflection values.
- K. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the Engineer for approval.

2.4 GRATING FABRICATION

- A. Measurements: Grating supplied shall meet the minimum dimensional requirements as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. Determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

- B. Layout: Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating supports shall be provided at openings in the grating by the Contractor where necessary to meet load/deflection requirements specified herein. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.
- C. Sealing: All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.
- D. Hardware: Type 316 stainless steel hold-down clips shall be provided and spaced at maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

PART 3 EXECUTION

3.1 INSPECTION

- A. Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor prior to the beginning of any fabrication work so that inspection may be provided. The grating shall be as free, as commercially possible, from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

3.2 INSTALLATION

- A. Contractor shall install gratings in accordance with manufacturer's assembly drawings. Fasten grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

END OF SECTION

DIVISION 07 – THERMAL AND MOISTURE PROTECTIONS

SECTION 07 19 00 WATER REPELLENTS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Penetrating water-repellent coatings for vertical surfaces of exterior exposed unit masonry.
 - 2. Pigmented penetrating sealer for vertical surfaces of exterior exposed concrete.
- B. Related Sections:
 - 1. Division 04 Section "Concrete Unit Masonry" for unit masonry assemblies.
 - 2. Division 07 Section "Sealants and Caulking."

1.2 PERFORMANCE REQUIREMENTS

- A. Absorption: Minimum 90 percent reduction of absorption after 24 hours in comparison of treated and untreated specimens.
 - 1. Concrete Unit Masonry: ASTM C 140.
- B. Water-Vapor Transmission: Maximum 15 percent reduction in rate of vapor transmission in comparison of treated and untreated specimens, per ASTM E 96.
- C. Permeability: Minimum 80 percent water-vapor transmission in comparison of treated and untreated specimens, per ASTM D 1653.
- D. Water Penetration and Leakage through Masonry: Minimum 90 percent reduction in leakage rate in comparison of treated and untreated specimens, per ASTM E 514.

1.3 SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Submit qualifications of applicator, stating applicator has a minimum of three years' experience using the specified or similar product.

- B. Pre-installation Conference: Conduct at Project Site with attendance of parties directly affecting work of this section, including General Contractor, Architect, Applicator and Manufacturer's Representative. Review environmental regulations, test panel procedures, protection of surrounding areas and non-masonry surfaces, surface preparation, application procedures, field quality control, final cleaning, and coordination with other work.

1.5 PROJECT CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied according to Manufacturers' written instructions and warranty requirements:
 1. Ambient temperature is above 40 deg F. and below 95 deg F.
 2. Substrate is dry and there is no frozen moisture in the substrate.
 3. Windy conditions do not exist that may cause water repellent to be blown onto vegetation or surfaces not intended to be treated.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which Manufacturer agree(s) to replace materials that fail to maintain water repellency specified in Part 1 "Performance Requirements" Article within specified warranty period.
 1. Warranty Period: Ten years water repellent from date of Substantial Completion.
 2. Complete Sections 1 and 2 of Manufacturer's Warranty Application and submit to Manufacturer for review and approval prior to water repellent installation.
 3. Complete Section 3 of Manufacturer's Warranty Application and submit to Manufacturer upon completion of water repellent installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Professional Products of Kansas, Inc., 4456 S. Clifton, Wichita, KS 67216; Tel: 800-676-7346; 316-522-9300; Fax: 316-522-9346; Email: ppk@watersealant.com; Web: www.watersealant.com

2.2 PENETRATING WATER REPELLENTS

- A. The water repellent products specified are selected as a standard of quality based upon Manufacturer's recommendations for execution.

- B. Products
 - 1. Professional Water Sealant, PWS-15 Super Strength
- C. Performance: Water repellent shall:
 - 1. Penetrate the surface and cure to silicone rubber, which remains below the surface and prevents water and paint from penetrating and bonding while permitting moisture vapor transmission. The silicone rubber retains its characteristic 400 percent elongation, allowing for the bridging of hairline cracks.
 - 2. Be unaffected by ultraviolet light, airborne pollutants, salt spray or acid rain.
 - 3. Cure to a clear, flat finish. Slight darkening or enhancement is acceptable.
- D. Request for substitutions will be considered in accordance with the following provision:
 - 1. Proposed alternate products shall be equal in terms of chemical composition and performance standards. Products shall be a penetrating, breathable treatment using a room temperature vulcanizing (RTV) silicone rubber base. Silane and siloxane-based products will not be considered.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean all dirt, oil, grease, mold, mildew, efflorescence, or any other coating or material from surfaces that interfere with penetration, performance, adhesion, or aesthetics of water repellents. Rinse thoroughly to remove cleaner residues. Allow surfaces to dry completely before application of water repellents.
- B. Repair, patch, and fill all cracks, voids, defects, and damaged areas in surface as approved by the Architect. Allow repair materials to cure completely before application of water repellents.
- C. Allow new masonry and concrete construction and repointed surfaces to cure for a minimum of 28 days before application of water repellents.
- D. Protect shrubs, metal, glass, vehicles, painted surfaces, surfaces to be painted and other building hardware from overspray. Special precautions should be taken to avoid fumes from entering the building being treated. Ventilation systems and fresh air intakes shall be turned off and covered.

- E. Coordination with Sealants: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent/graffiti barrier and to instruct Applicator on the product and application method to be used, and to field test the surfaces after application.
- B. Apply water repellent in accordance with Manufacturer's written instructions, using appropriate method and coverage rate as determined by mock-up testing results. Apply to all exterior masonry surfaces.

3.3 INSPECTION

- A. Manufacturer's Field Services: Provide services of Manufacturer's representative to inspect and approve the substrate before application, to instruct the applicator on the product and application method to be used, and to field test the surfaces after application.
- B. Water Uptake Test: After water repellent has cured for a minimum of 10 days, perform RILEM Test Method II.4 water uptake test on a minimum of 10 locations on the completed Project to confirm conformance with test panel results.

3.4 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water repellent/graffiti barrier as work progresses. The Contractor shall remove all equipment, material, and debris, leaving the area in an undamaged and acceptable condition. Dispose of material containers according to state and local environmental regulations.
- B. Repair, restore, or replace to the satisfaction of the Architect, all materials, landscaping, and non-masonry surfaces damaged by exposure to material application.

END OF SECTION

**SECTION 07 21 00
THERMAL INSULATION**

PART 1 GENERAL

1.1 SUMMARY

- A. Applications of insulation specified in this Section include rigid foam board and loose-fill type systems.
- B. The extent of insulation work is shown on Drawings and indicated by provisions in this Section.
- C. Section includes:
 - 1. Building insulation.
 - 2. Installation.
- D. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.

1.2 SUBMITTALS

- A. Submit a complete list of products, product information, types, and grades for approval by the Engineer prior to beginning building construction.

1.3 PRODUCT HANDLING

- A. General Protection:
 - 1. Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow.
 - 2. Comply with Manufacturer's recommendations for handling, storage, and protection during installation.

PART 2 PRODUCTS

2.1 MATERIALS

- A. R Value: Minimum R value shall be as shown in Drawings or as required by current Washington State Energy Code.
- B. Stud Walls and Ceilings
 - 1. Insulation in framed walls and ceilings shall be fiberglass batting with kraft paper faced with stapling flanges.
 - 2. Manufacturer: Owens/Corning Fiberglass, Manville, or equal.
- C. Light Shafts and Vent Ducts

1. Insulation in framed skylight light shafts and vent ducts in attic spaces shall be rigid cellular polyurethane, polystyrene, or polyisocyanurate foam board insulation.
- D. Loose-Fill Insulation
1. Perlite insulation shall conform to ASTM C549.
 2. Cellulose fiber loose-fill insulation shall conform to ASTM C739.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installer must examine substrates and conditions under which insulation work is to be performed and must notify Contractor in writing of unsatisfactory conditions.
- B. Do not proceed with insulation work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.
- C. Install insulation system in accordance with Manufacturer's recommendations or requirements.
- D. Set vapor barrier faced units with vapor barrier to warm side (winter) of construction.
- E. Do not obstruct ventilation spaces, except for firestopping.

END OF SECTION

**SECTION 07 41 13
METAL ROOF PANELS**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install a standing seam interlocking panel metal roof system with concealed fasteners where shown on the Drawings and as specified herein.

- B. Section includes:
 - 1. Metal roof panels
 - 2. Metal finishing
 - 3. Roofing membranes
 - 4. Slip sheeting
 - 5. Fasteners
 - 6. Fabrication of metal roof panels

- C. Related Sections:
 - 1. Section 06 05 00 - Fasteners and Adhesives.
 - 2. Section 06 10 00 - Rough Carpentry.

1.2 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. ASTM A792 - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - 3. ASTM D2626 - Standard Specification for Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing.

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

- B. Product data and materials list of items proposed to be provided under this Section.
- C. Sufficient technical data to demonstrate compliance with the specified requirements.
- D. Samples, to include preformed panel, seam, fastener, base sheet, finish sheet, ridge, and trims.

1.4 QUALITY ASSURANCE

- A. Use skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.
- B. In addition to complying with requirements of governmental agencies having jurisdiction, comply with:
 - 1. Underwriters' Laboratories, Inc., Class 90 wind uplift.
 - 2. Underwriters' Laboratories, Inc., UL 790, Class A roof assembly a fire rating.
 - 3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) -- Pertinent recommendations contained in the "Architectural Sheet Metal Manual".
- C. Warranty: Installer and Manufacturer shall furnish a written 5-year warranty stating that they will be responsible for replacement at their cost of any portion of the roof system that leaks due to defects in material or installation.

1.5 DELIVERY, HANDLING, AND STORAGE

- A. Comply with Manufacturer's requirements for product delivery, handling, and storage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Panels:
 - 1. 16-inch maximum width
 - 2. Continuous length
 - 3. Interlocking
 - 4. Hot-dipped zinc coated steel sheets, ASTM A653, Grade C, ASTM A792 zinc coating, surface treated for maximum coating performance

5. Minimum 26-gauge thickness.
- B. Metal Finish:
1. Polyvinylidene fluoride resin (minimum 70 percent resin) finish coat applied over baked-on compatible prime coat.
 2. One-mil minimum total coating system thickness.
 3. Color: In Manufacturer's standard color as selected by Owner.
- C. Roofing Membrane: Comply with ASTM D2626, Type 1, 30-pound.
- D. Anchors: 1-inch long, large head galvanized wood screws.

2.2 FABRICATION

- A. Shop fabricate to the maximum extent practicable.
- B. Brake-form to the indicated profiles, length, and width.

2.3 ACCEPTABLE MANUFACTURERS

- A. ASC Pacific, Inc., Tacoma, Washington
- B. Bruce & Dana, Inc., Salem, Oregon
- C. Ray F. Becker, Co., Portland, Oregon

PART 3 EXECUTION

3.1 INSTALLATION

- A. General
 1. Do not allow the installed work of this Section to be used as a storage space for other materials.
 2. Do not permit unnecessary walking on the finished roof. Require all personnel to wear rubber-soled shoes when installing or walking on the finished surfaces.
 3. Install per approved submittal drawings only.
 4. Discrepancies between Site conditions and Drawings as approved shall be brought to the attention of the Engineer for resolution.

- B. Apply the specified roofing membrane over the entire area to be covered by sheet metal roofing.
 - 1. Start at the low edge, and place succeeding courses shingle fashion, lapping edges 2-inch minimum.
 - 2. Lap the membrane with flashings as necessary to provide a positive barrier against penetration of water.
- C. Apply the specified slip sheet over the entire assembly, scatter nail to sheathing as required to hold in position prior to application of metal panels.
- D. Install concealed anchor cleats at minimum 18-inch centers into roof sheathing.
- E. Install preformed metal panels in strict accordance with Manufacturer's approved written installation instructions.
 - 1. Do not drive fasteners through panels or seams.
 - 2. Do not use tools or methods that scratch or mar the finish on exposed surfaces.

3.2 CLEANING AND PROTECTION

- A. Damaged Units: Replace panels and other components of the Work which have been damaged or have deteriorated beyond successful repair by means of finish touch-up or similar minor repair procedures.
- B. Cleaning:
 - 1. Remove protective coverings and strippable films (if any) at time in Project construction sequence which will afford greatest protection of Work.
 - 2. Clean finished surfaces upon completion of Work as recommended by Panel Manufacturer.
- C. Protection: Installer shall advise the Contractor of protection and surveillance procedures, as required to ensure that Work of this Section will be without damage or deterioration at time of substantial completion.

END OF SECTION

**SECTION 07 60 00
FLASHING AND SHEET METAL**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install flashing and sheet metal work, including gutters and downspouts, as indicated on the Drawings and by provisions of this Section.
- B. Section includes:
 - 1. Galvanized metal flashings
 - 2. Prefinished galvanized downspout and gutter

1.2 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - 2. ASTM G90 - Standard Practice for Performing Accelerated Outdoor Weathering of Nonmetallic Materials Using Concentrated Natural Sunlight

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Samples of flashing design, size, and color for approval
 - 2. Preparation instructions and recommendations
 - 3. Storage and handling requirements and recommendations
 - 4. Installation methods

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Per Manufacturer's recommendations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pre-finished Galvanized Steel Sheet:

1. Steel Sheet: 24-gauge, commercial quality.
2. Finish: Complying with ASTM A653, ASTM G90 for hot-dip galvanizing.
 - a. Pre-finished with baked-on polyester coating, not less than 1.0-mil thick.
3. Color: Provide material in color selected by Owner.

B. Galvanized Steel Sheet:

1. Steel Sheet: 24-gauge minimum, commercial quality.
2. Finishing: Galvanized, with minimum of 0.20 percent copper content. Complying with ASTM A653, G90 for hot-dip galvanizing, mill phosphatized, unless otherwise indicated.

C. Gutter and Downspots:

1. Material: 24-gauge galvanized sheet metal.
2. Fabrication: K-style or fascia style.
3. Metal Finish:
 - a. Polyvinyl fluoride resin (minimum 70 percent resin) finish coat applied over baked-on compatible prime coat.
 - b. 1.0-mil minimum total coating system thickness.
 - c. Color: In manufacturer's standard color as selected by Owner. Color to match roofing.

D. Miscellaneous Materials and Accessories

1. Solder: Except as otherwise indicated or recommended by Metal Manufacturer, provide 100 percent lead free solder for tinning and soldering galvanized metal joints.
2. Visually Exposed Fasteners: Stainless steel pop rivets with heads finished to match color of pre-finished metal material.

3. Concealed Fasteners: Zinc coated, type as required and recommended by Manufacturer for materials and substrates involved.
4. Mastic Sealant -- Polyisobutylene, non-hardening, non-skinning, non-migrating sealant typical for flashing lap joint applications.

2.2 FABRICATED UNITS

A. General

1. Shop fabricate metal counter flashings, cap and sill flashings, and similar items to comply with profiles and sizes shown, and to comply with standard industry details as shown by SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) in the "Architectural Sheet Metal Manual."
2. Comply with metal producers' recommendations for tinning, soldering, and cleaning flux from galvanized metal fabrications. Provide stainless steel rivets at exposed fastenings in pre-finished metal fabrications.
3. Form exposed sheet metal work without oil-canning, buckling and tool marks, true to line and level with exposed edges folded back to form hems.
4. Where movable joints are required for proper installation of mastic sealant, in compliance with SMACNA standards.

B. Pipe Jack Sleeve Fastenings

1. Fabricate pipe, roof penetration sleeves from galvanized material fully tinned and soldered at seams. Provide stack sleeve of diameter 1/2-inch greater than penetrating pipe and same height above with 3-inch-high conical base and embedment flange 12-inch greater than diameter of base. Furnish flanges at top of stack sleeve for attachment of counter flashing cap.
2. Fabricate counter flashing cap with interior pipe sleeve and conical cap to fit over pipe and stack sleeve. Size interior sleeve to tightly fit pipe diameter and to into pipe not less than 3 inches. Size conical cap to extend not less than 3 inches below top of stack sleeve with space above to permit not less than 1-inch pipe movement. Rivet counter flashing cap to flanges of stack sleeve.

C. Counter Flashings

1. Fabricate counter flashings from galvanized material to size and profiles shown in 10-foot minimum lengths with continuous 20-gauge galvanized cleat at hemmed lower drip edge.

2. Where top leg of counter flashing is not covered by other applied materials or otherwise supported, provide with integral hemmed sealant dam and anchor to wall substrates with 1/8-inch by 1-1/2-inch galvanized float bar, prepared with fastener holes drilled or punched at 8-inch on center. Coordinate size of holes with anchors to be used. Form sealant dam with 3/4-inch minimum outward-turned hemmed leg.
3. At inside and outside corners, provide double lapped, tinned and fully soldered assemblies, shop assembled prior to installation. Do not solder flashing corners after installation other than to render remedial surface repairs. If joint separation should occur, remove flashings and re-solder as required.

D. Cap Flashings

1. Fabricate lap seamed cap flashings from galvanized material with hemmed drips on both sides and continuous 20-gauge galvanized cleat at front edge.
2. Shop assemble cap end-to wall closure flashings with double lapped, riveted, and mastic sealed construction. Provide vertical legs with sealant dam as required for counter flashings.

E. Wall Flashings

1. Fabricate wall flashings from galvanized material with flat locked, mastic filled vertical seams spaced not greater than 4 feet on-center.
2. Form as required to closely follow substrate profile and interlock with counter and cap flashing assemblies without exposed fasteners. Secure to walls with 20-gauge galvanized cleat concealed by edge hems.

PART 3 EXECUTION

3.1 GENERAL

- A. Comply with Manufacturer's instructions and recommendation for handling and installation of flashing and sheet metal work.
- B. Coordination:
 1. Coordinate Work with other work for the correct sequencing of items which make up the entire membrane or system of weatherproofing and rain drainage.
 2. Coordinate Work of this Section with interfacing and adjoining work for proper sequence of each installation.

- C. It is required that the flashing and sheet metal work be permanently water-tight, and not deteriorate in excess of Manufacturer's published limitations.
- D. Provide flashing and sheet metal work which is fully compatible with interfacing or adjoining work to ensure the best total assembly performance for weather resistance and durability.

3.2 INSTALLATION OF METAL WORK

- A. Comply with details and profiles as shown and comply with SMACNA "Architectural Sheet Metal Manual" recommendations for installation of the work.
- B. Non-Moving Seams: Provide sealed flat-lock seams, except as otherwise indicated. Comply with metal producers' recommendations for tinning, soldering, and cleaning the joints of soldered work.
- C. Provide for thermal expansion of all exposed sheet metal work exceeding 20-foot running length, except as otherwise indicated.
- D. Conceal fasteners and expansion provisions wherever possible. Fold back edges on concealed side of exposed edges, to form a hem and stiffen material.
- E. Provide flashing reglets as shown or as required to seal work to existing substrates. Seal assembled joint with sealant as indicated.
- F. Do not proceed with the installation of flashing and sheet metal work until curb and substrate construction, blocking, and other construction to receive the work is completed.
- G. Examine the substrate and the conditions under which flashing, and sheet metal work is to be performed. Do not proceed with the work until unsatisfactory conditions have been corrected.
- H. Install gutters continuously without joints

3.3 CLEANING AND PROTECTION

- A. Clean visually exposed metal surfaces and other surfaces indicated to be painted. Remove corrosive substances, including soldering flux, which might cause deterioration of metal surfaces or final finish.
- B. Provide surveillance and protection of flashings and sheet metal work during construction to ensure that work will be without damage or deterioration at time of acceptance by Owner.

END OF SECTION

SECTION 07 72 33

ROOF HATCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Work under this section includes, but is not limited to, furnishing all labor and materials necessary for the complete and proper installation of an insulated roof hatch system as shown on the Drawings and in accordance with the requirements of the Contract Documents.

1.2 SUBMITTALS

- A. As required by Section 01 33 00, Submittals.

1.3 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.4 WARRANTY

- A. Provide manufacturer's written 5-year warranty. Contractor shall warrant materials and workmanship against defects after completion and final acceptance of work for up to 5 years.

1.5 DELIVERY, HANDLING AND STORAGE

- A. Comply with manufacturer's requirements for product delivery, handling and storage.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.
- B. Size: As shown on the drawings. Sizes refer to clear opening dimensions.
- C. Operation: Provide hatches with an opening angle of at least 87 degrees.

- D. Provide factory insulated aluminum sheet metal roof hatch, minimum cover thickness of 11-gauge, factory prime-coated for finish painting at the job site. Color to match metal roofing.
- E. Provide hatch with minimum R-value of 3. Cover and curb shall be fully insulated to ensure weather tightness and energy efficiency.
- F. Lifting mechanisms: 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.
- G. Hatch shall be furnished with a manual winch operator for remote opening and closing of the hatch and winch shall be accessible at finished floor elevation. Coordinate final location of winch operator with Owner. Winch operator shall be furnished and installed complete with wall mounting bracket, cable, pulleys and other ancillary parts for proper operation.
- H. Curb:
 - 1. Curbs shall be 12" in height and of 11-gauge aluminum. The curb shall be formed with a 3-1/2" flange with 7/16" 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.
 - 2. Contractor shall coordinate curb installation and materials with roof installation and materials.
- I. Acceptable Products
 - 1. Bilco
 - 2. Solar Innovations
 - 3. Babcock-Davis
 - 4. Equal products of other manufacturers when approved in advance by the Owner.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Coordinate as necessary with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.
- B. Install the work of this section in strict accordance with the manufacturers' recommendations as approved by the Owner, anchoring all items firmly into position for long life under hard use.
- C. Put operating components through at least five complete operating cycles, adjusting as required, and achieving optimum ease of operation.

END OF SECTION

**SECTION 07 92 00
SEALANTS AND CAULKING**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install sealing or caulking joints between dissimilar materials for watertight seal.
- B. Section includes:
 - 1. Sealants
 - 2. Filler gaskets
 - 3. Primers and bond breakers

1.2 DEFINITIONS

- A. Sealants: Where the words “sealants” or “caulking” are used in this text, they shall be considered to be synonymous and shall mean sealant or caulking compounds as specified under Part 2 of this specification.

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Product data and materials list of items proposed to be provided under this Section.
- C. Sufficient technical data to demonstrate compliance with the specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Type A Sealant
 - 1. Application: General building sealant.
 - 2. Material: One component polyurethane sealant.
 - a. Vulkem 116, as manufactured by Tremco.
 - b. MasterSeal NP1, as manufactured by BASF.

- B. Type B Sealant
 - 1. Application - General building sealant for wide joints.
 - 2. Materials - Self leveling one component polyurethane.
 - a. Vulkem 45, as manufactured by Tremco
- C. Filler Gasket (Backer Rod) Cord Strip
 - 1. Ethafoam, as manufactured by Dow Chemical
 - 2. Sonolastic Closed-cell Backer Rod, as manufactured by Sonneborn
 - 3. Equal, as approved by Engineer

PART 3 EXECUTION

3.1 PREPARATION

- A. Surfaces to receive caulking materials shall be thoroughly clean and free of any non-compatible primers or protective coatings, including lacquers, form coatings, clear sealers, etc.
- B. Brush out all foreign matter and loose particles.
- C. Clean metal surfaces with solvents and wipe dry while the surface is still wet with solvent.

3.2 INSTALLATION

- A. Primers and Bond Breakers
 - 1. Apply to surfaces as required; verify with Manufacturer.
 - 2. In general, prime all concrete and Portland cement-based plaster or grout surfaces.
 - 3. Prime wood surfaces where specifically required.
 - 4. Use proper type primers and bond breakers, apply per Sealant Manufacturer's printed instructions.
- B. Sealants
 - 1. Provide watertight caulked joints at all building exterior locations where possible water penetration through joint may occur.

2. If caulking systems for such joints are not shown, provide as specifically approved.

C. Gaskets or Fillers

1. Compress all gaskets to tight fit. Where required as backing for caulking system, roll or stretch in gasket sections to depth from sealant face or as shown (in general, to 3/8-inch).
2. Install gun grade material with gun nozzle of similar size as joint width as shown. Tool all beads, after application to assume full firm contact. Strike off excess material.
3. Maintain edge surfaces adjacent to joints clean and free of caulking stain and excess material. Trim joints as required per Manufacturer's printed instructions.
4. Do not apply caulking materials to a "bleeding" type of surface, such as asphaltic or other oil-emitting types. Where such material occurs at caulking joint (roofing, etc.), isolate from caulking with gasket filler.
5. Avoid mixing any water in caulking mixture before and during application. Do not thin material.

3.3 CORRECTIONS AND CLEANUP

- A. Remove all damaged, defective, or improperly installed sealant and/or caulking and replace.
- B. Clean and remove all sealant and caulking from adjacent surfaces.
- C. Upon completion of the work, remove all disused implements, rubbish, and debris, and leave premises neat and clean.

END OF SECTION

DIVISION 08 – DOORS AND WINDOWS (OPENINGS)

**SECTION 08 10 00
METAL DOORS AND FRAMES**

PART 1 GENERAL

1.1 SUMMARY

- A. The work specified in this Section includes providing metal doors and door frames for the booster pump and treatment building of the described size, type and thickness specified herein and shown on Drawings.

1.2 SUBMITTALS

- A. Comply with the requirements of Section 01 33 00.
- B. For Aluminum Curtain Roll-up Doors
 - 1. Product Data: Provide general construction, component connections and details, electrical equipment.
 - 2. Shop Drawings: Indicate pertinent dimensioning, anchorage methods, hardware locations, and installation details.
 - 3. Manufacturer's Instructions: Indicate installation sequence and procedures, adjustment and alignment procedures.
 - 4. Maintenance Data: Indicate lubrication requirements and frequency and periodic adjustments required.
- C. For Single Swing, Vertical Hung Doors and Frames
 - 1. Product Data: Submit manufacturer's technical product data substantiating that products comply with requirements.
 - 2. Shop Drawings: Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
 - 3. Provide schedule of doors and frames, using the door numbers as they appear in the Door Schedule on the Drawings.
 - 4. Provide details demonstrating coordination of glazing frames and stops with glass and glazing requirements, in accordance with the door numbering noted above.

1.3 RELATED SECTIONS

- A. Section 08 71 00, Door Hardware.
- B. Section 09 90 00, Painting and Coating.

1.4 QUALITY ASSURANCE

A. Materials:

1. All material used in the fabricating of steel doors and frames shall be free from defects impairing strength, durability, and appearance. Doors shall conform to Commercial Standard CS 242-62 and PS4-66.
2. Doors and frames in accordance with Standard Steel Door Institute (SDI) recommendations -- SDI 100-78, extra heavy duty, Type III, 16 gauge, galvanized steel.
3. Doors and frames to be of a single manufacturer.
4. Doors shall be capable of meeting energy code requirements. See Sheet A-1 of the Drawings for performance path requirements.

B. Hardware:

1. See Section 08 71 00, Door Hardware.
2. Reinforce, drill and tap doors and frames to receive mortised hinges, locks, latches, flush bolts and concealed closer as required.
3. Hardware preparation in accordance with SDI 107. Contractor to drill and tap for surface applied hardware in accordance with SDI 107.

PART 2 PRODUCTS

2.1 MATERIALS

A. Single Swing, Vertically Hung Doors

1. Doors
 - a. 1-3/4 inch full flush, fabricated from two sheets 16 gauge galvanized steel with no visible seams on either face.
 - b. Reinforced, stiffened, and sound deadened.
 - c. Exterior doors shall be insulated with polyurethane cores while interior doors shall be insulated with polystyrene cores. Refer to Sheet A-1 of the Drawing for minimum U factor requirements.

- d. Bonderized and finished with standard one-coat baked-on prime coat.
- e. Doors to be thoroughly degreased and cleaned of all imperfections before finish painting is applied per Section 09 90 00 Painting and Coating. Provide drip caps on exterior doors and louvers or glazing on interior doors where indicated on the Drawings.
- f. Doors shall be provided with 3/16-inch steel hinge reinforcements, 1/8-inch steel lock reinforcements all securely welded into place and each drilled and tapped to receive field installed finish hardware and shall open outward.
- g. Doors shall be mortised for automatic door bottom seals where required by hardware group or fire rating.

2. Door Frame

- a. Manufacturer's standard, rigid, fully welded door frame provided in size as detailed, 16 gauge galvanized steel, double rabbet.
- b. Frames shall be furnished with standard one-coat baked-on prime coat ready to receive specified finish paint systems.
- c. Anchor doors to opening in accordance with manufacturers recommendations.
- d. All hardware shall be of manufacturer's standard design except as described in Section 08 71 00 Door Hardware of these specifications.

- 3. Provide doors, frames, hardware, and accessories with appropriate fire ratings as required by local and state codes.
- 4. Double doors shall have removable mullion or no mullion so the full opening is available for equipment ingress/egress.
- 5. Accepted Manufacturer – doors shall be manufactured by Steelcraft Manufacturing Co. or approved equal.

B. Aluminum Curtain Roll-up Door

- 1. Door opening shall be as shown on the Drawings.
- 2. Door shall be an insulated, weather-stripped service door provided with interlocking roll-formed slats.
- 3. Fabricate interlocking sections with high strength nylon endlocks on alternate slats each secured with two ¼-inch rivets. Provide windlocks as required for windload protection.

4. Front slats shall be fabricated of 0.040-inch aluminum. Slats shall have an anodized finish. Color(s) to be selected by Owner from manufacturer's standard colors.
5. Back slats shall be fabricated of 0.040-inch aluminum. Slats shall have an anodized finish. Color(s) to be selected by Owner from manufacturer's standard colors.
6. Curtain bottom to be reinforced and windload protection provided. Slat cavity filled with CFC-free foamed-in-place, closed cell urethane insulation. Include manufacturer accessories as necessary for minimum installed system Sound Transmission Class (STC) value of 22 (STC rating of 30 for curtain).
7. Hood shall be minimum 24-gauge steel with reinforced top and bottom edges, galvanized in accordance with ASTM A 653. Provide minimum ¼-inch steel intermediate support brackets as required to prevent excessive sag. Provide Atmoshield Powder Coating System prime and finish coat for rust inhibition and scratch resistance. Powder coating finish shall be applied to hood, guides, bottom bar and headplate. Color(s) to be selected by Owner from manufacturer's standard colors. Non-galvanized exposed ferrous surfaces shall receive one coat of rust-inhibitive primer.
8. Mounting of door shall be by face of wall mounting bracket with a continuous channel guide.
9. 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. Chain hoist to include integral brake mechanism that will immediately stop upward or downward travel and maintain the door in a stationary position when the hand chain is released by the user. Locate chain as shown on the Drawings.
10. Provide chain keeper lock and all other hardware and accessories per manufacturer standard design.
11. Accepted Manufacturers and models – Cornell Iron Works – Thermiser Max, Model ESD30 or approved equal.

PART 3 EXECUTION

3.1 PRODUCT HANDLING

A. Delivery and Storage:

1. Deliver and store doors and frames at the job site in dry area, complete protection between doors to insure against surface damage. Take special care at all times to prevent staining of door surface. Carry doors and frames when moving them; do not drag; do not slide one door across another.

B. Replacements:

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

3.2 INSTALLATION

- A. Install plumb, straight, true, rigidly secured in place and properly braced all in accordance with manufacturer's recommendations.
- B. Solid grout frames at all exterior doors.
- C. Fit and install specified hardware to operate freely and adjust doors before final acceptance.

3.3 CORRECTIONS AND CLEANUP

- A. Immediately after erection, sand smooth all rusted, or damaged areas of prime coat and apply touch up compatible primer.

END OF SECTION

**SECTION 08 71 00
DOOR HARDWARE**

PART 1 GENERAL

1.1 DESCRIPTION

- A. The Work specified in this Section includes the requirements for furnishing and installing door hardware as designated in the Contract.
 - 1. Furnish door hardware in accordance with hardware groups scheduled. Coordinate with existing plant master keying system.
 - 2. Furnish templates and hardware list of hardware as required.

1.2 DEFINITIONS

- A. References
 - 1. American National Standards Institute (ANSI)
 - a. A115.1 – Specification for Standard Steel Door and Frame Preparation for Mortise Locks and 1-3/8-inch and 1-3/4-inch Doors.
 - b. A156.18 – Materials and Finishes.
 - 2. ASTM International (ASTM)
 - a. E90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - b. E152 – Fire Tests of Door Assemblies
 - c. E283 – Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors.
 - 3. Door and Hardware Institute (DHI) - A115 Series
 - a. RL - Recommended Locations for Builders Hardware for Standard Steel Doors and Frames.
 - 4. Underwriter Laboratories (UL)
 - a. 10B – Fire Tests of Door Assemblies
 - 5. International Building Code (IBC)

6. NFPA 101: Life Safety Code

1.3 SUBMITTALS

- A. Comply with the requirements of Section 01 33 00.
- B. Product Data: Submit Contractor's product data for each item of door hardware, installation instructions, and maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
 - 1. Final hardware schedule, incorporating the Owner's Representative's door numbering system, coordinated with doors, frames, and related Work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 2. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size, and finish of each hardware item.
 - b. Name and Contractor of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of each hardware set cross-referenced to indications on the Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of all abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.
 - h. Keying information.
- C. Templates for doors, frames, and other Work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.4 QUALITY ASSURANCE

- A. Supplier shall have a factory direct status with all manufacturers specified.

1.5 PROJECT CONDITIONS

- A. Coordinate the Work with other directly affected Sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
- B. Provide construction cylinders during Project's construction through arrangement with the specified Cylinder Contractor. Return-for-credit arrangements with Cylinder Contractor at the end of construction.
- C. Coordinate Owner's keying requirements during the course of the Work.

PART 2 PRODUCTS

2.1 MATERIALS

A. Contractors

1. Acceptable Manufacturers: As follow:

- a. Butts and Hinges: McKinney, Stanley, Ives. "MCK, STN, IVE"
- b. Lockset and Latchset: Best lock. "BST"
- c. Cylinders: Best lock. "BST"
- d. Overhead Closers: LCN, Norton. "LCN, NTN"
- e. Stops: Rockwood. "RWD"
- f. Gasketing: Pemko. "PEM"
- g. Thresholds: Pemko. "PEM"
- h. Latch Guards: Glynn-Johnson. "GLN"
- i. Panic Bar Exit Devices: Yale. "YALE"
- j. Astragals: Pemko. "PEM"
- k. Acoustical Door Seals: Acoustical Solutions. "ACS"

B. General

1. Fasteners

- a. Furnish necessary screws, bolts, and other fasteners of suitable size and type to anchor the hardware in position for long life under hard use.

- b. Where necessary, furnish fasteners with toggle bolts, expansion shields, sex bolts, and other anchors approved by the Owner's Representative, according to the material to which the hardware is to be applied and according to the recommendations of the Hardware Contractor.
 - c. Provide fasteners, which harmonize with the hardware as to finish and material.
 2. Where butts are required to swing 180 degrees, furnish butts of sufficient throw to clear the trim.
 3. Furnish silencers for doorframes at the rate of three for each single door and two for each door or pair of doors except weather-stripped doors and doors with light seals, smoke seals or sound seals.
 4. Tools and Manuals: Deliver to the Owner one complete set of adjustment tools and one set of maintenance manuals for locksets, closers, and panic devices in accordance with Project close-out requirements.

C. Keying

1. Door Locks: The city will provide all keys and keying, using Best 5AAA keyway system to establish the facility standards.
2. Provide a construction keying system for Contractor's and/or City's use during construction. Provide five construction keys for City use during construction period. Contractor shall retain construction keys and inserts and turn over to the City upon completion of construction.
3. Coordinate the changeover to permanent keyways with the City at completion of station commissioning.

D. Hinges

1. Provide butt hinges of the five-knuckle, full mortise type, having two or four ball or iolite bearing as noted, stainless steel pins, and complying with ANSI A156.1.
2. Provide all out swinging doors to the exterior with butt hinges of the stainless steel or non-ferrous materials, with non-removable pins of the set screw.
3. Hinge size: Door 1-3/4-inch in thickness to 38-inch in width shall be provided with 4-1/2-inch x4-inch butt hinges provided with at least two ball or iolite bearing; wider and heavier doors with 5-inch x 4-1/2-inch extra heavy butt hinges provided with four ball or iolite bearing.

4. Number of hinges per door leaf: Provide three hinges per leaf for door up to 86-inch high, one additional butt hinge for each additional 30 inches of height, or fraction thereof.

E. Locksets and Latchsets

1. Cylinders: The Contractor shall furnish and install all screw-in type cylinders and keyways to establish the facility standard. The Contractor shall provide construction cylinders and keys for use during construction. Following acceptance, City will re-key the cylinders with Bestlock 5AAA cylinders.
2. Lock Type: For all exterior doors where cylindrical locksets or latches are called for, provide locks of the Best 9K Heavy Duty Lever Type, with backset of 2-3/4-inch, unless otherwise noted. Provide all locks for the entire Project from the same manufacturer.
3. Design: Provide lever handles at all locksets of the Best 9K Series, unless otherwise noted.
4. Strikes: Provide each lockset, handset, or deadlock with a box strike. Provide standard type strikes with extended lips where required to protect adjacent trim from being marred by latch bolt. Verify cutout types provided in metal frames.
5. All padlocks shall be provided and installed by the Owner when it takes over the operation of the facility. During construction, the Contractor is to provide temporary construction padlocks as needed. Contractor is to provide the Owner a minimum of five construction keys for use during the construction period.

F. Closers

1. General
 - a. Comply with IBC Section 1010.1.3 for maximum effort to operate doors.
 - b. Closers are attached with sex bolts.
 - c. Adjust closers in accordance with Contractor's directions for size of door.
 - d. Provide modern closers having:
 - 1) Full rack and pinion with steel spring and non-gumming, nonfreezing hydraulic fluid.
 - 2) Provide complete set of separate controls for regulating sweep speed, latch speed, backcheck, and backcheck positioning. Sizes as recommended by reviewed Contractor.

2. Door Surface Applied Modern Closers
 - a. Provide drop plates at doors having narrow frames.
 - b. Product: LCN or equal.
 3. Quantity: Provide each leaf in pairs of doors scheduled to receive closers.
- G. Stops and Holders
1. It is the intent of these specifications that each door leaf is provided with a door stop.
 2. Built-in stops in door closers, wall bumpers, and overhead stops, where called for, shall satisfy the requirements of this paragraph. Provide stops of proper size and height to prevent doors from hitting walls of fixed objects.
- H. Thresholds
1. Thresholds shall conform to BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum and shall provide proper clearance and an effective seal with specified gasketing. Threshold shall be set in a full bed of mastic.
 2. Provide countersink, flathead screws, same material, and finish as threshold.
- I. Door Bottom
1. Door Bottoms shall be surface type with aluminum housing cover, anodized clear finish. Door bottoms shall have a neoprene seal and shall be actuated by the opening and closing of the door. The door bottoms shall exclude light when the door is in the closed position and shall inhibit the flow of air through the unit.
 2. Provide countersink, flathead screws, same material, and finish as door bottom.
- J. Gasketing
1. Gasketing shall be compressive type seal, silicon based, self-adhesive product for use on steel door frames with steel doors for 20 minutes and 1-hour B labels. Air leakage rate of weather-stripping shall not exceed 0.5 cubic feet per minute per linear foot of crack when tested in accordance with ASTM E283 at standard test conditions.
 2. Provide countersink, flathead screws, same material, and finish as door gasketing.
- K. Silencers

1. Provide each door with a press-metal frame with rubber silencers. Omit at doors to receive gasketing. Provide each single door with three silencers, each pair of doors with four.
- L. Panic Bars / Exist Devices
1. Double doors to have mortice lock exit device on active door and manual flush bolts on inactive door.
 2. Single doors to have rim panic device.
- M. Acoustical Door Seals
1. Provide acoustical door seals for all gaps around the door including, but not limited to, head, jamb, threshold, and astragal.
 2. Provide automatic door bottoms and coordinate with threshold.
- N. Finishes
1. All hardware shall have brushed chrome finish (626) for interior and exterior installation typically, unless noted otherwise.
 - a. Provide over steel base metal (BHMA 626), typical, where required by code.
 - b. Provide over bronze base metal (BHMA 612) for exterior installations and unheated spaces expose to the weather, unless otherwise noted. Exterior installations include exit doors to covered exterior pads and walkway locations, loading dock areas, areaways, and where noted.
 2. All thresholds and weather-strip shall be fabricated of extruded aluminum, clear anodized finish, to match specified finish of other aluminum, unless noted otherwise.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install hardware in accordance with Contractor's instructions and requirements of AMSI/NFPA 80, and DHI. Use the templates provided by the Hardware Item Contractor.
- B. Provide architectural finish hardware with all necessary (plus prudent spares) screws, bolts, or other devices or fastenings of suitable size and type to secure the hardware in position for heavy use and long life, harmonizing as to material and finish. These fastening shall be furnished, where necessary, with expansion shields or other approved anchors according to the material to which it is applied and as recommended

by the Contractor. Secure all hardware to concrete with expansion sleeve anchors as indicated by best current practice; plastic or "Rawl" plugs will not be permitted. Hardware screws shall be of sufficient length to firmly engage backing and shall be fully threaded. All screws normally exposed to view, including all screws for butt hinges, shall have "Phillips" heads, finish to match hardware.

C. Keying:

1. City will remove construction plugs and install permanent cylinders as required.
2. The master key chart will be furnished by the City. The City is responsible for all keying and permanent keys. Contractor shall provide construction cylinders and keys as required during construction.

3.2 FINISHING

A. Typical: Brushed stainless steel, US32D.

B. Adjusting, Cleaning, and Demonstrating

1. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made. The operation of the ventilation system does not cause doors to slam shut or fail to close completely.
 - a. Adjust operation of all doors to meet ADA and IBC 1010.1.3 for requirements for opening force.
 - b. Where door hardware is installed more than 1 month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area.
 - c. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

C. Clean adjacent surfaces soiled by hardware installation.

D. Instruct Owner's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

3.3 SCHEDULE OF DOOR HARDWARE GROUPS

HW GROUP: 01

DOOR NUMBER:

D1, D2, D3

<u>QTY</u>	<u>UNIT</u>	<u>ITEM</u>	<u>MODEL NO.</u>	<u>FINISH</u>	<u>MFR</u>
8	EA	HINGE	5BB1-HW 4.5 X 4.5	626	IVE
2	EA	EXTENSION FLUSH BOLT	458B26D	626	IVE
1	EA	LOCKSET	93K7D15D	626	BST
1	EA	STRIKE	S3	626	BST
1	EA	CYLINDER	86B	626	BST
1	EA	ASTRAGAL	by door mfr	---	---
2	EA	SURFACE CLOSER	4011	626	LCN
1	SET	GASKETING	S44D (HEAD & JAMBS)	BRN	PEM
1	EA	DOOR STOP	461L	626	RWD
2	EA	PANIC BAR	7130	626	YALE
2	EA	ACOUSTICAL AUTOMATIC DOOR BOTTOM	PDB411AE	626	PEM
2	EA	ACOUSTICAL THRESHOLD	2008_PK	626	PEM

HW GROUP: 02

DOOR NUMBER:

D4

<u>QTY</u>	<u>UNIT</u>	<u>ITEM</u>	<u>MODEL NO.</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1-HW 4.5 X 4.5	626	IVE
1	EA	LOCKSET	93K7D15D	626	BST
1	EA	STRIKE	S3	626	BST
1	EA	CYLINDER	86B	626	BST
1	EA	ASTRAGAL	by door mfr	---	---
1	EA	SURFACE CLOSER	4011	626	LCN
1	SET	GASKETING	S44D (HEAD & JAMBS)	BRN	PEM
1	EA	DOOR STOP	461L	626	RWD
1	EA	PANIC BAR	7130	626	YALE
1	EA	ACOUSTICAL AUTOMATIC DOOR BOTTOM	PDB411AE	626	PEM
1	EA	ACOUSTICAL THRESHOLD	2008_PK	626	PEM

HW GROUP: 03

DOOR NUMBER:

D6, D7, D8

<u>QTY</u>	<u>UNIT</u>	<u>ITEM</u>	<u>MODEL NO.</u>	<u>FINISH</u>	<u>MFR</u>
4	EA	HINGE	5BB1-HW 4.5 X 4.5	626	IVE
1	EA	STRIKE	S3	626	BST
1	EA	CYLINDER	86B	626	BST
1	EA	ASTRAGAL	by door mfgr	---	---
1	EA	SURFACE CLOSER	4011	626	LCN
1	SET	GASKETING	S44D (HEAD & JAMBS)	BRN	PEM
1	EA	DOOR STOP	461L	626	RWD
1	EA	PANIC BAR	7130	626	YALE

END OF SECTION

**SECTION 08 91 19
FIXED LOUVERS**

PART 1 GENERAL

1.1 DESCRIPTION

A. Scope:

1. This Section includes intake and exhaust stationary air louvers and accessories.

B. Section Includes:

1. Louvers
2. Screens

C. Related Sections:

1. Section 05 50 00 - Metal Fabrications
2. Section 09 90 00 - Painting and Coatings

1.2 SUBMITTALS

- A. Manufacturer's catalog and/or other data confirming conformance to specified design, material, and equipment requirements.
- B. Certified results of pressure drop test data and water penetration data. The equipment list should identify each louver with an equipment number and indicate the room or structure in which it is located.
- C. Louvers shall bear the AMCA certified ratings seal for both air performance and water penetration.

1.3 REFERENCE STANDARDS

- A. Aluminum Association (AA):
 1. AA 45 - Designation System for Aluminum Finishes.
- B. Air Movement and Control Association (AMCA) International:
 1. AMCA Standard 500 - Test Methods for Louvers, Dampers, and Shutters.
- C. ASTM International (ASTM):

1. ASTM B221 - Aluminum and Aluminum Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

PART 2 PRODUCTS

2.1 MANUFACTURERS

Manufacturers include Airlite, Construction Specialties, Greenheck, and Ruskin, or equal.

2.2 MATERIALS

- A. Frame: ASTM B221, 6063-T52 extruded aluminum alloy
- B. Fasteners: Aluminum
- C. Bird Screen

2.3 EQUIPMENT

- A. Blades:
 1. Material: ASTM B221, 6063-T52 extruded aluminum alloy
 2. Blades shall be of the combination of fixed and adjustable, drainable type with interlocking blade braces to provide an uninterrupted horizontal line.
 3. Blades for all louvers shall be minimum 0.081-inch thick.
 4. Slideable interlocked mullions shall have provisions for expansion and contraction.
- B. Frame:
 1. Material: ASTM B221, 6063-T52 extruded aluminum alloy
 2. The frame shall be minimum 0.081-inch thick by 4 inches deep.
 3. The louver frame shall be assembled by welding.
 4. The head, sill, and jamb shall be one-piece structural members and shall have an integral calking slot and retaining bead.
- C. Screen:
 1. Material: Aluminum wire mesh
 2. The louver shall be furnished with a removable bird screen constructed of 1/2-inch mesh, 16-gauge wire and secured within a 10-gauge extruded aluminum frame.

3. The screen shall be mounted on the interior louver face but independent of the louver.
- D. Fasteners: Aluminum.
- E. Finish:
1. Unless otherwise specified, all louvers shall receive an AAMA 2605, 70 percent fluoropolymer paint finish after assembly.
 2. Minimum coating thickness shall be 0.7-mil.
 3. Color to match door.

2.4 FABRICATION

- A. General: Fabricate louvers to comply with requirements indicated for design, dimensions, materials, joinery, and performance.
- B. Assemble louvers in shop to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Maintain equal louver blade spacing to produce uniform appearance.
- E. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances of louvers, adjoining construction and perimeter sealant joints.
- F. Include supports, anchorages and accessories required for complete assembly.
- G. Provide vertical mullions of type and at spacing's indicated but not more than recommended by Manufacturer, or 72 inches on center, whichever is less. At horizontal joints between louver units, provide horizontal mullions except where continuous vertical assemblies are indicated.
- H. Provide sill extensions and loose sills made of same material as louvers where indicated or required for drainage to exterior and to prevent water penetrating to interior.
- I. Join frame members to one another and to fixed louver blades as follows, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary:
1. With fillet welds, concealed from view.

2. With fillet welds, concealed from view; or mechanical fasteners; or a combination of these methods; as standard with Louver Manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Locate and place louver units plumb, level, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items that cannot be refinished in the field to the shop, make required alterations and refinish entire unit, or provide new units.
- F. Protect nonferrous metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that are in contact with concrete, masonry, or dissimilar metals.
- G. Install concealed gaskets, flashings, joint fillers, and insulation, as louver installation progresses, where required to make louver joints weathertight. Comply with Section 07 92 00 for sealants applied during installation of louver.

3.2 FINISHING

- A. Adjusting and Protection
 1. Protect louvers from damage of any kind during construction period including use of temporary protective coverings where needed and approved by Louver Manufacturer. Remove protective covering at time of Substantial Completion.
 2. Restore louvers damaged during installation and construction period, so that no evidence remains of correction work. If results of restoration are unsuccessful, as judged by the Owner's Representative, remove damaged units, and replace with new units.

- a. Clean and touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

B. Cleaning

1. Periodically clean exposed surfaces of louvers that are not protected by temporary covering to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
2. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Rinse surfaces thoroughly and dry.

END OF SECTION

DIVISION 09 - FINISHES

**SECTION 09 20 10
GYPSUM WALLBOARD**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the work necessary to furnish and install gypsum drywall and accessories where shown on the Drawings, as specified herein and as needed for a complete and proper installation.

- B. Section includes:
 - 1. Gypsum wallboard
 - 2. Metal trim
 - 3. Jointing systems
 - 4. Fastening devices
 - 5. Access doors

- C. Related Sections:
 - 1. Section 06 10 00 - Rough Carpentry.

1.2 REFERENCE STANDARDS

- A. ASTM International (ASTM):
 - 1. ASTM C514 - Standard Specification for Nails for the Application of Gypsum Board.
 - 2. ASTM C1396 - Standard Specification for Gypsum Board.

1.3 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.

- B. Product Data: Manufacturer's data sheets on each product to be used.

1.4 QUALITY ASSURANCE

- A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Per Manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GYPSUM WALLBOARD

- A. General: Provide gypsum wallboard complying with ASTM C1396, in 48-inch widths and in such lengths as will result in a minimum of joints.
- B. Regular wallboard: Provide 5/8-inch thick, moisture resistant, except as may be shown otherwise on the Drawings.
- C. Fire-retardant wallboard: Provide Type X, 5/8-inch thick.
- D. Fire-resistant wallboard: Provide Type C, 5/8-inch thick, except as may be shown otherwise on the Drawings.
- E. Foil-backed wallboard -- Provide as shown on the Drawings.

2.2 METAL TRIM

- A. Form from zinc-coated steel not lighter than 26-gauge, complying with Fed Spec QQ-S0775, Type I, class D or E.
- B. Casing beads
 - 1. Provide channel shapes with an exposed wing and with a concealed wing not less than 7/8-inch wide.
 - 2. The exposed wing may be covered with paper cemented to the metal but shall be suitable for joint treatment.
- C. Corner beads
 - 1. Provide angle shapes with wings not less than 7/8-inch wide and perforated for nailing and joint treatment or with combination metal and paper wings bonded for joint treatment.
- D. Edge beads for use at perimeter of ceilings
 - 1. Provide angle shapes with wings not less than 3/4-inch wide.
 - 2. Provide concealed wing perforated for nailing and exposed wing edge folded flat.

3. Exposed wing may be factory-finished in white color.

2.3 JOINTING SYSTEM

- A. Provide a jointing system, including reinforcing tape and compound, designed as a system to be used together and as recommended for this use by the Manufacturer of the gypsum wallboard approved for use on this Work.
- B. Jointing compound may be used for finishing if so recommended by its Manufacturer.

2.4 FASTENING DEVICES

- A. For fastening gypsum wallboard in place on metal studs and metal channels, use flat-head screws, shouldered, specially designed for use with power-driven tools, not less than 1-inch long, with self-tapping threads and self-drilling points.
- B. For fastening gypsum wallboard in place on wood, use 1-1/4-inch type W bugle-head screws or annular ring type nails complying with ASTM C514 and of the length required by governmental agencies having jurisdiction.

2.5 ACCESS DOORS

- A. In partitions and ceilings installed under this Section, provide doors where required for access to mechanical installations, electrical installations, and attic spaces.
- B. Types:
 1. Unless otherwise required, provide 22-inch by 30-inch metal access doors with concealed hinges to metal frame and with Allen key lock.
 2. For piercing fire-rated surfaces, provide access doors having the same fire rating as the surface being pierced.
 3. Provide prime-coated steel access doors and frames for finish painting to be performed at the job site under Section 09 90 00, Painting and Coating.

2.6 OTHER MATERIALS

- A. Provide other materials not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Examine the areas and conditions under which work of this Section will be performed.
- B. Correct conditions detrimental to timely and proper completion of the Work.
- C. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

A. General:

- 1. Install gypsum wallboard in accordance with the Drawings and with the separate boards in moderate contact but not forced into place.
- 2. At internal and external corners, conceal the cut edges of the boards by the overlapping covered edges of the abutting boards.
- 3. Stagger the boards so that corners of any four boards will not meet at a common point except in vertical corners.

B. Ceilings:

- 1. Install gypsum wallboard to ceilings with the long dimension of the wallboard at right angles to the supporting members.
- 2. Wallboard may be installed with the long dimension parallel to supporting members that are spaced 16-inch on centers when attachment members are provided at end joints.

C. Walls:

- 1. Install the gypsum wallboard to studs at right angles to the furring or framing members.
- 2. Make end joints, where required, over framing or furring members.

D. Attaching:

- 1. Drive the specified screws with clutch-controlled power screwdrivers, spacing the screws 12 inches on centers at ceilings and 16 inches on centers at walls.
- 2. Where framing members are spaced 24 inches apart on walls, space screws 12 inches on centers.

3. Attach double layers in accordance with the pertinent codes and the Manufacturer's recommendations as approved by the Engineer.
 4. Attach to wood as required by governmental agencies having jurisdiction.
- E. Access Doors:
1. By careful coordination with the Drawings and with the trades involved, install the specified access doors where required.
 2. Anchor firmly into position and align properly to achieve an installation flush with the finished surface.

3.3 JOINT TREATMENT

- A. General:
1. Inspect areas to be joint treated, verifying that the gypsum wallboard fits snugly against supporting framework.
 2. In areas where joint treatment and compound finishing will be performed, maintain a temperature of not less than 55 degrees Fahrenheit (F) for 24 hours prior to commencing the treatment and until joint and finishing compounds have dried.
 3. Apply the joint treatment and finishing compound by machine or hand tool.
 4. Provide a minimum drying time of 24 hours between coats with additional drying time in poorly ventilated areas.
- B. Embedding Compounds:
1. Apply to gypsum wallboard joints and fastener heads in a thin uniform layer.
 2. Spread the compound not less than 3-inch wide at joints, center the reinforcing tape in the joint, and embed the tape in the compound. Then spread a thin layer of compound over the tape.
 3. After this treatment has dried, apply a second coat of embedding compound to joints and fastener heads, spreading in a thin uniform coat to not less than 6-inch wide at joints, and feather edged.
 4. Sandpaper between coats as required.
 5. When thoroughly dry, sandpaper to eliminate ridges and high points.
- C. Finishing Compounds:

1. After embedding compound is thoroughly dry and has been completely sanded, apply a coat of finishing compound to joints and fastener heads.
2. Feather the finishing compound to not less than 12-inch wide.
3. When thoroughly dry, sandpaper to obtain a uniformly smooth surface, taking care to not scuff the paper surface of the wallboard.

3.4 CORNER TREATMENT

A. Internal Corners:

1. Treat as specified for joints, except fold the reinforcing tape lengthwise through the middle and fit neatly into the corner.

B. External Corners:

1. Install the specified corner bead, fitting neatly over the corner and securing with the same type fasteners used for installing the wallboard.
2. Space the fasteners approximately 6-inch on centers and drive through the wallboard into the framing or furring member.
3. After the corner bead has been secured into position, thread the corner with joint compound and reinforcing tape as specified for joints, feathering the joint compound out from 8-inch to 10-inch on each side of the corner.

3.5 OTHER METAL TRIM, GENERAL

- A. The Drawings do not purport to show all locations and requirements for metal trim.
- B. Carefully study the Drawings and the installation and provide all metal trim normally recommended by the Manufacturer of the gypsum wallboard approved for use in this Work.

3.6 CLEANING UP

- A. In addition to other requirements for cleaning, use necessary care to prevent scattering gypsum wallboard scraps and dust, and to prevent tracking gypsum and joint finishing compound onto floor surfaces.
- B. At completion of each segment of installation in a room or space, promptly pick up and remove from the working area all scrap, debris, and surplus material of this Section.

END OF SECTION

**SECTION 09 90 00
PAINTING AND COATING**

PART 1 GENERAL

1.1 SUMMARY

- A. Work under this Section shall include the protective coating of all specified surfaces including all surface preparation, pretreatment, coating application, touch-up of factory coated surfaces, protection of surfaces not to be coated, cleanup, and appurtenant work, all in accordance with the requirements of the Contract Documents.

1.2 JOB REQUIREMENTS

- A. This specification is applicable to coated pipe, steel, concrete, and other surfaces listed in the coating schedule at the end of this section.
- B. The Coating System Schedules summarize the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to show or extend the limits of coating systems, or to clarify or show details for application of the coating systems.
- C. Related Work Specified in Other Sections -- Shop coatings and/or factory finishes on fabricated or manufactured equipment may be specified in other divisions. Some items with factory finishes, or corrosion resistant finishes may be scheduled or directed to be painted by the Engineer to unify a wall finish or color scheme, at the Engineer's discretion.
- D. Exclusions -- Do not coat the following surfaces unless specified or directed elsewhere: Stainless steel, aluminum, copper, brass, bronze, and other corrosion-resistant material (except for valve bodies and piping); Electrical switch-gear and motor control centers having factory finish; Fencing; Multiple coated factory finished baked enamel or porcelain products; Concealed areas such as ducts, piping, conduits, and items specified elsewhere for special linings and coatings.
- E. Damaged Factory Finish -- If directed by the Engineer, refinish the entire exposed surfaces of equipment chipped, scratched, or otherwise damaged in shipment or installation.
- F. All coating coming in contact with potable water shall be NSF approved.

1.3 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Comply with the provisions of the following codes, specifications, and standards, except as otherwise shown or specified.
 - 1. "Architectural Specification Manual" by the Painting and Decorating Contractors of America (PDCA), 333 Taylor Avenue North, Seattle, Washington 98109.
 - 2. "Systems and Specifications" - Volume 2 of Steel Structures Painting Council (SSPC).
 - 3. NSF International (NSF) Standard No. 61.
 - 4. NSF International (NSF) Standard No. 600 – Health Effects Evaluation and Criteria for Chemicals in Drinking Water (Effective beginning January 1, 2023)
- B. References herein to "NACE" shall mean the published standards of the National Association of Corrosion Engineers, P.O. Box 986, Katy, TX 77450.
- C. Pipe Coating Commercial Standards

ANSI/AWWA C105	Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquids.
ANSI/AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
ANSI/AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4-inch and Larger - Shop Applied
ANSI/AWWA C209	Cold Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Pipelines.
ANSI/AWWA C210	Liquid Epoxy Coating for Exterior and Interior of Steel Pipe.
ANSI/AWWA C213	Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
ANSI/AWWA C214	Tape Coating systems for the Exterior of Steel Water Pipelines.

1.4 CONTRACTOR SUBMITTALS

- A. Coating Materials List -- The Contractor shall provide a coating materials list which indicates the Manufacturer and the coating number, keyed to the coating systems herein. The amount of copies to submit shall be as specified within Section 01 33 00, Submittal Procedures.

- B. Coating Manufacturer's and Applicator Information -- For each coating system to be used the Contractor shall submit, the following listed data.
1. Manufacturer's data sheet for each product used, including statements on the suitability of the material for the intended use.
 2. Manufacturer's instructions and recommendations on surface preparation and application.
 3. Colors available for each product and each coat.
 4. Compatibility of shop and field applied coatings (where applicable).
 5. Material safety data sheet (MSDS) for each product used.
 6. The Manufacturer's recommended products and procedures for field coating repairs and field preparation of field cut pipe ends.
 7. The name of the proposed coating applicator shop along with certification that the applicator shop is qualified and equipped to apply the coatings systems as specified.
 8. Certificate -- Submit Manufacturer's certificate of compliance with the specifications and standards signed by a representative in the Manufacturer's employ.
 9. Samples -- Provide painted surface areas at the job for approval of main color selections or submit sample on 12-inch sample of substrate using required finish system at Engineer's discretion.

1.5 QUALITY ASSURANCE

- A. Painter Qualifications -- The Painting/Coating Contractor must be capable of performing the various items of work as specified. The Painting/Coating Contractor shall furnish a statement covering experience on similar work, a list of machinery, plant, and other equipment available for the proposed work, and a financial statement, including a complete statement of the Painter/Coating Contractor's financial ability and experience in performing similar painting and coating work. The Painting/Coating Contractor shall have a minimum of 5 years practical experience and a successful history in the application of the specified products to concrete/steel surfaces. Upon request, the Painting/Coating Contractor shall substantiate this requirement by furnishing a list of references, which shall include jobs of similar nature.
- B. The Contractor shall give the Engineer a minimum of 3 days advance notice of the start of any field surface preparation work of coating application work, and a minimum of 7 days advance notice of the start of any shop surface preparation work.

- C. All such work shall be performed only in the presence of the Engineer unless the Engineer has granted prior approval to perform such work in its absence.
- D. Inspection by the Engineer, or the waiver of inspection of any particular portion of the work, shall not relieve the Contractor of its responsibility to perform the work in accordance with these Specifications.
- E. Surface Preparation -- Evaluation of blast cleaned surface preparation work will be based upon comparison of the blasted surfaces with the standard samples available from the NACE, using NACE standard TM-01-70.
- F. Scaffolding shall be erected and moved to locations where requested by the Engineer to facilitate inspection. Additional illumination shall be provided by the Contractor to cover all areas to be inspected.
- G. Paint Products -- No request for substitution shall be approved which decreases the film thickness designated or the number of coats to be applied, or which offers a change from the generic type of coating specified. Painting shall be done at such times as the Contractor and Engineer may agree upon in order that dust-free and neat work be obtained. All painting shall be in strict accordance with the Manufacturer's instructions and shall be performed in a manner satisfactory to the Engineer.
- H. Manufacturer's Representative -- Require Coating Manufacturer's representative to be at job site when the first day's coating application is in progress and periodically during progress of the work.
- I. Labels -- Deliver to the job site in the original sealed containers with Manufacturer's name, product name, type of product, Manufacturer's specification or catalog number or federal specification number, and instructions for reducing where applicable.
- J. Colors -- Colors will be selected from Manufacturer's standard colors as reviewed by Engineer and approved by the Owner. Colors for special coatings that are limited in their availability and color selection will be chosen on the basis of Manufacturer's standard colors, provided that the Manufacturer's product line represents a color range comparable to similar products of other manufacturers.
- K. Flame Spread -- Provide paint materials which will result in a Class II finish for all coated surfaces in exit corridors, and a Class III finish for all other interior rooms or areas.
- L. Film Thickness Testing -- On ferrous metals, the dry film coating thickness shall be measured in accordance with the SSPC "Paint Application Specification No. 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 wet film gauge readings and destructive film thickness tests.

- M. Inspection Device -- The Contractor shall furnish, until final acceptance of such coatings, inspection devices in good working condition for the detection of holidays and measurement of dry-film thicknesses of protective coatings. Dry-film thickness gauges shall be made available for the Engineer's use at all times while coating is being done, until final acceptance of such coatings. The Contractor shall provide the services of a trained operator of the holiday detection devices until the final acceptance of such coatings.
- N. Holiday Testing -- The Contractor shall holiday test all coated ferrous surfaces. Areas which contain holidays shall be marked and repaired or recoated in accordance with the Coating Manufacturer's printed instructions and then retested.
 - 1. Coatings With Thickness Exceeding 20 Mils -- For surfaces having a total dry film coating thickness exceeding 20 mils: pulse-type holiday detector such as Tinker & Razor 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 specified coating thickness.
 - 2. Coatings With Thickness of 20 Mils or Less -- For surfaces having a total dry film coating thickness of 20 mils or less: Tinker & Razor 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 non-sudsing type wetting agent, such as Kodak Photo-Flo, or equal, shall be added to the water prior to wetting the detector sponge.

1.6 DELIVERY, HANDLING, AND STORAGE

- A. Deliver in labeled containers as specified above and store in a locked room accessible for inspection. Comply with fire and health regulations.
- B. Provide adequate heat and forced mechanical ventilation for health, safety, and drying requirements. Use explosion proof equipment. Provide face masks.
- C. Protect adjacent surfaces with suitable masking and drop cloths as required. Remove cloths or waste from the Project daily.
- D. Apply to surfaces under recommended environmental conditions and within the limitations established by the Material Manufacturer. Do not apply coating in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or to damp or wet surfaces, unless otherwise permitted by the Coating Manufacturer's printed instructions. Coating application may be continued during inclement weather only if

the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the Paint Manufacturer during application and drying periods.

1.7 PROTECTION

- A. Follow all safety recommendations of Manufacturer regarding ventilation and danger from explosion or breathing paint fumes or skin exposure, and all applicable O.S.H.A. and other regulations.
- B. Protect surface adjacent to work being coated from overspray, drips or other damage.

1.8 EXTRA STOCK

Provide one gallon of each type and color, fully labeled, at completion of job.

PART 2 PRODUCTS

2.1 GENERAL

- A. Definitions -- The terms "paint," "coatings," or "finishes" as used herein, shall include surface treatments, emulsions, enamels, paints, epoxy resins, tape, and all other protective coatings, excepting galvanizing or anodizing, whether used as a pretreatment, primer, intermediate coat, or finish coat. The term "DFT" means minimum dry film thickness.
- B. General -- Coating materials shall be sealed in containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, Manufacturer's directions, and name of Manufacturer, all of which shall be plainly legible at the time of use.
- C. The Contractor shall use coating materials suitable for the intended use and recommended by their Manufacturer for the intended service.
- D. Compatibility -- In any coating system only compatible materials from a single manufacturer shall be used in the work. Particular attention shall be directed to compatibility of primers and finish coats. If necessary, subject to the approval of the Engineer, a barrier coat shall be applied between existing prime coat and subsequent field coats to ensure compatibility.
- E. Colors -- All colors and shades of colors of all coatings shall be as selected or specified by the Engineer. Each coat shall be of a slightly different shade, to facilitate inspection of surface coverage of each coat. Finish colors shall be as selected from the Manufacturer's standard color samples by the Engineer. Color pigments shall be lead free.

- F. Protective Coating Materials -- Products shall be standard products produced by recognized manufacturers who are regularly engaged in production of such materials for essentially identical service conditions. Where requested, the Contractor shall provide the Engineer with the names of not less than 10 successful applications of the proposed Manufacturer's products demonstrating compliance with this specification requirement.
- G. Substitute or "Or-Equal" Submittals -- Unless otherwise specified, materials are from the catalogs of the companies listed herein. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the companies listed. The Contractor shall provide satisfactory documentation from the firm manufacturing the proposed substitute or "or equal" material that said material meets the specified requirements and is equivalent or better than the listed materials.
- H. The cost of all testing and analyzing of the proposed substitute materials that may be required by the Engineer shall be paid by the Contractor. If the proposed substitution requires changes in the contract work, the Contractor shall bear all such costs involved and the costs of allied trades affected by the substitution.

2.2 INDUSTRIAL COATING SYSTEMS

A. General

Provide and apply the industrial coatings systems which follow as listed in the coating schedule, as required by these specifications, and as directed by the Engineer. Coat all existing and new exposed interior or exterior surfaces and submerged and intermittently submerged surfaces as indicated, except as specifically excluded in Part 1 of this section or on the drawings or finish schedules. Coating System Numbers listed below shall be used as the Coating System code letter, and shall be used on any coating submittals or correspondence.

B. Industrial coating systems shall be as follows

1. Coating System 100

- a. Location -- Exposed, unprimed, non-galvanized, nonsubmerged metal surfaces, both interior and exterior including piping, and structural steel.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- Apply prime coat and topcoat, 4.0-6.0 mils each coat of Tnemec Series N69 Hi-Build Epoxoline, or equal. Color as selected by Owner.

2. Coating System 101

- a. Location -- Exposed metal surfaces, shop primed, both interior and exterior including piping, railings, ladders, steel doors, and any other metal items not otherwise specified.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply shop prime coat 3.0 mils DFT Tnemec Series 90-97 Tnemec-Zinc, one coat 4.0 - 6.0 mils DFT Tnemec Series N69 Hi-Build Epoxoline, and 3.0 - 4.0 mils DFT of Tnemec Series 1095 Endura Shield, or equal. Color as selected by Owner.
3. Coating System 102
- a. Location -- Unprimed or non-galvanized, continuously or intermittently submerged metal items, both interior and exterior including piping, structural steel, and all other metal items not otherwise specified.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prime, intermediate and topcoat, 4.0-6.0 mils each coat of Tnemec Series 22, or equal. Color as selected by Owner.
4. Coating System 103
- a. Location -- Vertical concrete walls, exterior, below finish grade, not exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Paint System -- Apply two coats 9.0-10.0 mils each, Carboline Bitumastic 50, or equal.
5. Coating System 104
- a. Location -- Non-submerged, exposed to view, PVC piping.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply one coat, 4.0-6.0 mils Tnemec Series 1095 EnduraShield, or equal. Color as selected by Owner.

2.3 SPECIAL PIPE AND SEVERE SERVICE COATING SYSTEMS

A. General

The following coatings are for buried pipe and surfaces used in severe service conditions. The Manufacturers' products listed in this paragraph are materials which

satisfy the material descriptions of this paragraph and have a documented successful record for long term submerged or severe service conditions. Proposed substitute products will be considered as indicated within the paragraph entitled " 'Or-Equal' Clause" in Section 01 10 00, Summary of Work.

- B. Special pipe and severe service coating systems shall be as follows
1. Coating System 200 -- Cement Mortar Coating
 - a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- A 1-1/2-inch minimum thickness mortar coating reinforced with 3/4-inch galvanized welded wire fabric shall be provided. The cement mortar shall contain no less than 1-part Type V cement to 3 parts sand. The cement mortar shall be cured by a curing compound meeting the requirements of "Liquid Membrane-Forming Compounds for Curing Concrete" ASTM C 309-81, Type II, white pigmented, or by enclosure in an 8-mil thick polyethylene sheet with all joints and edges lapped by at least 6 inches. At the Engineer's discretion, the hot applied coal tar epoxy coating may be used as the curing membrane for the mortar coating.
 2. Coating System 201 -- Hot Applied Coal Tar Epoxy Coating
 - a. Location -- Exterior surface of concrete pipe and cement-mortar coated pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- The hot applied coal tar epoxy shall be a solvent free 100 percent solids coal tar epoxy chemically compatible with hydrating cement and suitable for application on moist surfaces of freshly placed cement mortar or concrete and properly prepared cured surfaces. The coal tar epoxy coating material shall be Amercoat 1972B or equal. The finish coal tar epoxy coating shall have a minimum DFT of 26 mils.
 3. Coating System 202 -- Coal-Tar Epoxy Coating System
 - a. Location -- Exterior surface of buried steel pipe, fittings, and other ferrous surfaces.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- High build, two-component amine or polyamide cured coal-tar epoxy shall have a solids content of at least 68 percent by volume, suitable

as a long term coating of buried surfaces, and conforming to AWWA C210. Prime coats are for use as a shop primer only. Prime coat shall be omitted when both surface preparation and coating are to be performed in the field. The coal-tar epoxy coating system shall include:

- 1) Prime coat (DFT = 1-1/2 mils), Amercoat 83HS, Tnemec P66, or equal.
- 2) Finish coats (Two or more, DFT = 18 mils), Amercoat 78 HB, Tnemec 46 H-413, or equal.
- 3) Total system DFT = 19-1/2 mils.

4. Coating System 203 -- Fusion Bonded Epoxy

- a. Location -- Ferrous surfaces of sleeve couplings, steel pipe, and fittings.
- b. Surface Preparation -- As specified herein.
- c. Coating System -- The coating material shall be a 100 percent powder epoxy applied in accordance with the ANSI/AWWA C213 "AWWA Standard for Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines". The coating shall be applied using the fluidized bed process.
 - 1) Liquid Epoxy -- For field repairs, the use of a liquid epoxy will be permitted, applied in not less than three coats to provide a DFT 16 mils. The liquid epoxy shall be a 100 percent solids epoxy recommended by the Powder Epoxy Manufacturer.
 - 2) Coating (DFT = 16 mils), Scotchkote 134, or equal.
 - 3) Total system DFT = 16 mils.

5. Coating System 204 -- Hot, Coal-Tar Enamel

- a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
- b. Surface Preparation - As specified herein
- c. Coating System -- Coal-Tar Enamel materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a primer layer, coal-tar enamel layer, coal-tar saturated non-asbestos felt outer wrap, and a finish coat. Total system DFT = 188 mils.

6. Coating System 205 -- Hot Applied Tape

- a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.

- b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C203. This system shall consist of a cold-applied liquid primer and heated coal-tar base tape. Total system DFT = 50 mils.
7. Coating System 206 -- Cold Applied Tape
- a. Location -- Exterior surfaces of buried steel pipe and fittings, non-galvanized.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Tape coating materials and procedures shall be in accordance with ANSI/AWWA C209. Prefabricated tape shall be Type II. The system shall consist of a primer layer, inner layer tape of 35 mils, and an outer layer tape of 35 mils. Total system DFT = 70 mils.
8. Coating System 207 -- PVC Tape
- a. Location -- Small galvanized steel pipe and fittings.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prior to wrapping pipe with PVC tape, the pipe and fittings 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 for a total thickness of 40 mils.
9. Coating System 208 -- Mastic
- a. Location -- Pipe and fitting joints, and general buried surface coating repair and touch up.
 - b. Surface Preparation - As specified herein.
 - c. Coating System -- Mastic shall be a one-part solvent drying heavy bodied thixotropic synthetic elastomeric coating with chemically inert resins and fillers and an average viscosity of 650,000 CPS at 77 degrees Fahrenheit (F), thereby requiring generous applications by hand or trowel. Total coat thickness shall be 30 mils, minimum. Mastic shall be Protecto Wrap 160 H or equal and be fully compatible with pipeline coating systems.
10. Coating System 209 -- Polyethylene Encasement
- a. Location -- Ductile iron, steel and concrete cylinder pipe and fittings
 - b. Surface Preparation -- None required.

- c. Coating System -- Except as otherwise specified, application of polyethylene encasement shall be in accordance with ANSI/AWWA C105 using Method C.

11. Coating System 210 – Wax Tape

- a. Location – Buried ductile iron and steel pipe fittings and couplings where specified.
- b. Surface Preparation – As specified herein
- c. Coating System -- Except as otherwise specified, application of wax tape installation shall be in accordance with ANSI/AWWA C217.

12. Coating System 211 – Zinc coating and polyethylene encasement

- a. Location – Buried ductile iron pipe and fittings
- b. Surface Preparation – As specified herein.
- c. Coating System – The exterior of the pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc applied shall be 200 grams per square meter (0.6554 ounces per square foot) of pipe surface. A finishing layer topcoat shall be applied to the zinc. Zinc coated pipe shall be use in conjunction with V-Bio polywrap installed per ANSI/AWWA C105 method C.

2.4 ARCHITECTURAL COATING SYSTEMS

A. General

"Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or topcoat.

Fungus Control: Submit evidence for all paints attesting the passing of Federal Test Method Standard No. 141, Method 6271.1 showing no fungus growth or other approved test results.

Apply to surfaces under recommended environmental conditions and within the limitations established by the Material Manufacturer. Acrylics require 60 degrees F and above temperature and below 50 percent relative humidity. Apply water-based paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F and 90 degrees F unless otherwise permitted by the Paint Manufacturer's printed instructions.

B. Architectural coating systems shall be as follows

1. Coating System 300
 - a. Location -- Vertical, exterior concrete masonry unit walls exposed to view.
 - b. Surface Preparation -- Surfaces shall be cleaned with a manufacturer's approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils, paint and other contaminants before the coating system is applied. Coating system shall be applied according to the manufacturer's published recommendations. A manufacturer's representative shall be present during application of the coating system, if required by the manufacturer's warranty.
 - c. Coating System -- Apply two flood coats of an RTV silicone rubber water repellent and graffiti protectant, Chemprobe Series 626 Dur A Pell GS, or equal. All coatings to be clear. Apply per manufacturer's instructions.
2. Paint System 301
 - a. Location -- Vertical concrete exterior walls and flat concrete exterior roofs and slabs exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply two coats 6.0-9.0 mils (100 ft²/gal) each coat, Themec Series 156 Envirocrete, or equal. Color as selected by Owner.
3. Paint System 302
 - a. Location -- Interior concrete masonry unit walls and interior and exterior wood walls, ceilings, and other wood surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Prime as specified by Coating Manufacturer. Apply two coats 6.0 - 9.0 mils (100 ft²/gal) each coat, Themec Series 156 Envirocrete, or equal. Color as selected by Owner.
4. Paint System 303
 - a. Location -- Wood surfaces not otherwise specified, exposed to view.
 - b. Surface Preparation -- As specified herein.
 - c. Coating System -- Apply an alkyd primer as recommended by the Manufacturer, 2 mils. Apply finish coats (two or more coats 6 mils total) of single component,

water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal.
Total DFT = 8 mils. Color as selected by Owner.

5. Paint System 304

- a. Location -- Interior drywall surfaces not otherwise specified, exposed to view.
- b. Surface Preparation - As specified herein.
- c. Coating System -- Apply two coats 2.0 - 3.0 mils each coat of single component, water based acrylic latex coating, Tnemec Series 6, Carboline 3350 or equal. Color as selected by Owner.

6. Paint System 305

- a. Location -- Exterior brick surfaces not otherwise specified, exposed to view.
- b. Surface Preparation -- Surfaces shall be cleaned with a Manufacturer's approved chemical cleaner and power washed. Surfaces shall be completely dry, free from efflorescence, oils, paint, and other contaminants before the coating system is applied. Coating system shall be applied according to the Manufacturer's published recommendations. A Manufacturer's representative shall be present during application of the coating system, if required by the Manufacturer's warranty.
- c. Coating System -- Apply two coats of masonry water retardant material. The system shall be clear, non-staining, silane-modified-siloxane, Fabrishield 161, Rainstopper 1500, or equal. The selected coating system shall provide a minimum of a 5-year Manufacturer's warranty.

7. Paint System 306

- a. Location – Interior concrete floors, equipment, and housekeeping pads.
- b. Surface Preparation - As specified herein
- c. Coating System – Tnemec
 - 1) Primer: Series 203 Epoxoprime LV, 6.0-8.0 mils.
 - 2) Finish: Series 280 Tnemec-glaze, 8.0–10.0 mils.
 - 3) Non-Skid: Disperse 50 mesh dry wash silica sand into wet prime coat. Apply finish coat per recoat of primer.
 - 4) Coves/Cants: Series 237 Power-Tread. Top coat per finish.

- 5) Reference Tnemec technical data sheet for application.
 - 6) Note: For repairs of chips or spalled areas, use Tnemec Series 218 Mortar Clad.
8. Coating System 307 – Intumescent Fire Protection Material
- a. Location – Exposed HGLB beam seats and associated nuts / bolts inside Generator Room.
 - b. Surface Preparation – Per manufacturer’s requirements.
 - c. Coating system – Sherwin- Williams
 - 1) Primer: Kem Kromik Universal Metal Primer #B50Z Series, 3.0 - 4.0 mils.
 - 2) Intermediate: Firetex FX5120, 265 mils Total DFT (minimum) or as required to meet 2-hour fire rating. Refer to UL263 Thickness Tables.
 - 3) Finish: Water based acrylic latex, two coats, 2.0 - 3.0 mils each coat. Color as selected by Owner.

PART 3 EXECUTION

3.1 STORAGE, MIXING, AND THINNING OF MATERIALS

- A. Manufacturer's Recommendations -- Unless otherwise specified herein, 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 all other procedures relative to coating shall be strictly observed.
- B. All protective coating materials shall be used within the Manufacturer's recommended shelf life.
- C. Storage and Mixing -- Coating materials shall be protected from exposure to cold weather, and shall be thoroughly stirred, strained, and kept at a uniform consistency during application. Coatings of different manufacturers shall not be mixed together.

3.2 SURFACE PREPARATION STANDARDS

- A. The following referenced surface preparation specifications of the Steel Structures Painting Council 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. High- and Ultra High- Pressure Water Jetting (SSPC-SP12): Water jetting at high- or ultra-high-pressure to prepare a surface for recoating using pressure above 10,000 pounds per square inch (psi).
9. Surface Preparation of Concrete (SSPC-SP-13) - Surface preparation of concrete by mechanical, chemical, or thermal methods prior to the application of bonded protective coating or lining systems.
10. Industrial Blast Cleaning (SSPC-SP14): Blast cleaning to remove all visible oil, grease, dust and dirt, when viewed without magnification

3.3 CORRECTIONS AND CLEANUP

At completion any damaged, de-laminated or defaced coated surfaces shall be touched up, restored, and left in first class condition. Any coated or finished surfaces damaged in fitting or erection shall be restored. If necessary, an entire wall shall be refinished rather than spot finished. Upon completion and prior to final acceptance, all equipment and unused materials accumulated in the coating process shall be removed from the site and any spillage, spatter spots or other misplaced coating material shall be removed in a manner which will not damage surfaces. Perform required patching, repair, and cleaning to the satisfaction of the

Engineer. Cooperate and coordinate work with the work of other trades in the removal and replacement of hardware, fixtures, covers, switch plates, etc., as required for coating.

3.4 SURFACE PREPARATION

A. General

Prepare all surfaces scheduled to receive new coating systems, as required to provide for adequate bonding of the specified coating system to the substrate material. Request review of prepared surfaces by the Engineer prior to proceeding. For existing coated surfaces, hand wash with cleaner or product recommended by Coating Manufacturer to properly prepare existing surface and provide for bonding of coating specified to follow. Remove any loose, peeling or flaking coating, or mildewed areas. Surface preparation minimums shall be as follows:

1. Exposed metal items, non-submerged, unprimed, non-galvanized both interior and exterior, including: piping, structural steel and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP6, "Commercial Blast Cleaning".
2. Exposed metal items, shop primed, both interior and exterior including: piping, steel doors, steel ladders to be painted, and railings, and all other metal items not otherwise specified, shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning"; SSPC-SP2, "Hand Tool Cleaning"; and SSPC-SP3, "Power Tool Cleaning" as may be required to remove grease, loose, or peeling or chipped paint.
3. Metal items, unprimed or non-galvanized, continuously or intermittently submerged, both interior and exterior including: piping, structural steel, and all other metal items not otherwise specified, shall undergo surface preparation in conformance with SSPC-SP10, "Near-White Blast Cleaning".
4. Stainless Steel – Non-submerged and submerged, exposed piping and fittings, both interior and exterior shall undergo surface preparation in accordance with SSPC-SP1, "Solvent Cleaning".
5. Polyvinyl Chloride (PVC) – Non-submerged, both interior and exterior, process piping and plumbing, shall be lightly sanded prior to application of the specified coating system to follow.
6. Non-submerged Concrete - Clean all concrete surfaces of dust, form oil, curing compounds, or other incompatible matter. Etch and prime if required by Manufacturer for specified coating products to follow. Allow minimum 28-day cure of concrete prior to application of coating systems.

7. Concrete Masonry Units -- Repair all breaks, cracks and holes with concrete grout. The surface must be free of dirt, dust, loose sand and other foreign matter. Brush clean. Allow minimum 28-day cure of concrete joint mortar and repair grout prior to application of coatings system.
8. Wood -- Wood surfaces shall be thoroughly cleaned and free of all foreign matter with cracks, nail holes, and other defects properly filled, smoothed, and sandpapered to fine finish. Wipe clean of dust.
9. Preparation of All Existing Coated Surfaces -- Removed rough and defective coating film from material surfaces to be painted. Touch up with approved primer. Clean all greasy or oily surfaces, to be painted, with benzine or mineral spirits or Rodda's Gresof before coating, or as recommended by Manufacturer. For walls, patch existing nicks and gouges, sand to match wall finish.

3.5 PRIME COATING

- A. Exposed Steel -- Prime coat all exposed steel in accordance with SSPC PS 13.01 for epoxy-polyamide coating systems. Prime coats shall be applied following completion of surface preparation requirements as specified in paragraph 3.4.A.1 above.
- B. Galvanized Metal -- After surface preparation specified above, prime galvanized metal items receiving paints as specified with Tnemec Series 66 Hi-Build Epoxaline or equal, verifying with Manufacturer before application the compatibility with coatings specified to follow.
- C. Shop Primed Metal -- Where indicated on the plans or coating schedule and following the surface preparation procedures specified in paragraph 3.4.A.2 above, the Contractor shall apply intermediate and topcoats of the specified paint system to shop primed metal. The Contractor shall verify with the Manufacturer(s) representative of the item(s) to be painted, before application, the compatibility of shop primers with the specified intermediate and topcoat coating systems.
- D. Non-Shop Primed Metal and Piping -- Prime coat all exposed metal and piping, except stainless steel, received at job site following completion of surface preparation requirements as specified in Paragraph 3.4.A.1 above. Prime paint in accordance with SSPC PS No. 13.01 for epoxy-polyamide primers. Epoxy-polyamide primers shall conform to the standards set forth in SSPC Paint Specification No. 22.
- E. Cast-In-Place Reinforced Concrete -- After surface preparation specified above, prime coat concrete as specified in the coating schedule found elsewhere in the specifications.
- F. Concrete Masonry Units -- After surface preparation specified above, prime coat as specified in the coating schedule found elsewhere in the specifications.

- G. Wood Surfaces -- Following surface preparation specified above, prime coat exterior exposed wood surfaces with appropriate coating system as specified in the painting schedule.

3.6 FIELD PRIME

Wherever shop priming has been damaged in transit or during construction, the damaged area shall be cleaned and touched up with field primer specified herein or returned to the shop for resurfacing and re-priming, at the Engineer's discretion. Metal items delivered to the job site unprimed shall be cleaned and primed as specified herein.

3.7 APPLICATION

- A. Thickness -- Apply coatings in strict conformance with the Manufacturer's application instructions. Apply each coat at the rate specified by the Manufacturer to achieve the dry mil thickness specified. If material must be diluted for application by spray gun, build up more coating to achieve the same thickness as undiluted material. Correct apparent deficiency of film thickness by the application of an additional coat.
- B. Porous Surfaces -- Apply paint to porous surfaces as required by increasing the number of coats or decreasing the coverage as may be necessary to achieve a durable protective and decorative finish.
- C. 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 working day.
- D. Coatings shall be applied in accordance with the Manufacturer's instructions and recommendations, and this Section, whichever has the most stringent requirements.
- E. Special attention shall be given to edges, angles, weld seams, flanges, nuts and bolts, and other places where insufficient film thicknesses are likely to be present. Use stripe coating for these areas.
- F. Special attention shall be given to materials which 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.
- G. Ventilation -- Adequately ventilate enclosed rooms and spaces during painting and drying periods.
- H. Drying Time -- Do not apply next coat of coat until each coat is dry. Test non-metallic surfaces with moisture meter. The Manufacturer's recommended drying time shall mean an interval under normal condition to be increased to allow for adverse weather or drying conditions. Coating Manufacturer's representative shall verify by cure testing, complete cure of coatings systems used for immersion service.

3.8 COATING SCHEDULE

Coating Schedule

<u>Item</u>	<u>Location</u>	<u>Material</u>	<u>Coating System</u>
Piping Linings (exterior surface of pipe)	Exposed Piping Inside Buildings and Vaults	Ductile Iron	Coating System 101
Doors	Pump Station	Steel	Coating System 101
Louvers	Pump Station	Aluminum	Coating System 101
Miscellaneous Metals	Pump Stations & Vaults (exterior surface)	Steel	Coating System 101
CMU Walls	Exterior of Pump Station	CMU	Coating System 300
Concrete Slabs	Floor of Pump Station	Concrete	Coating System 306
CMU Walls	Interior of Pump Station	CMU	Coating System 302

Notes:

1. Fusion bonded epoxy [ANSI/AWWA C213] can be substituted for coal tar epoxy. Potable water epoxy, NSF approved, shall be used for all surfaces in contact with potable water.
2. If a location and material are not specifically identified in the table, the coating systems specified in Section 2, Products, shall apply to the entire project as noted in the specifications for each coating system.

END OF SECTION

**SECTION 09 97 23.24
CONCRETE WATER STORAGE TANK PAINTING**

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section specifies the design and construction of rehabilitation and retrofit work to be completed on the existing concrete water storage tanks; including all site work, concrete tank cleaning, application of new coatings, concrete work, and disinfection directly related to the tank unless otherwise specified.

- B. Summary of Work
 - 1. Exterior cleaning of the tank wall
 - 2. Application of a new exterior architectural coating system to the wall
 - 3. Interior tank cleaning and sediment removal
 - 4. Preparation and elastomeric coating of interior wall cracks
 - 5. Final cleaning and disinfection of the tank interior

1.2 QUALITY ASSURANCE

- A. Qualifications & Experience

The contractor shall be a specialist tank contractor experienced in the rehabilitation of concrete water storage tanks, with the following minimum experience:

- 1. The rehabilitation, in their own name, of at least 10 concrete water storage tanks in the last 10 years of equal size or greater, which have been in successful service for a minimum of five (5) years since the work was completed.
- 2. The restoration of at least ten (10) concrete water storage tanks with deteriorated concrete/shotcrete walls and or domes within the last five (5) years.
- 3. A professional engineer on staff, registered in Washington State, experienced in the design and rehabilitation of concrete water storage tanks, who will be the specialist tank contractor's engineer of record for the project.

1.3 SUBMITTALS

- A. Contractor Standards

1. Company Personnel – Provide the names, project responsibilities, experience on similar projects and resumes for personnel responsible for the following:
 - Project Manager
 - Design Engineer
 - Site Superintendent
 - Quality Control Manager
2. Construction Equipment, Materials and Methods – Provide the following:
 - Summary of all equipment to be used in the rehabilitation of the tank.
 - Construction schedule and plan including labor requirements and responsibilities, sequencing, materials and methods.
 - Quality control plan and procedures including testing, correcting deficiencies, systems and methods, schedule, and responsibilities.
 - List all major suppliers and subcontractors who may work on this project.
3. The contractor shall sign and date the information provided and certify that to the extent of the Contractor’s knowledge, the information is true and accurate, and the design and construction supervisory personnel for the tank construction will be directly involved with and used on this project. Substitutions of personnel and/or methods will not be allowed without the written authorization of the Owner.

B. Construction Submittals for Review Prior to Use:

1. Design proportions for all concrete and shotcrete and concrete strengths of trial mixes for all concrete.
2. Admixtures to be used in the concrete and their purpose.
3. Shop drawings shall be stamped by Professional ENGINEER, experienced in the design of concrete water storage tanks and registered in the State of Washington.

1.4 GUARANTEE

- A. The CONTRACTOR shall guarantee the work against defective materials or workmanship for a period of one (1) year from the date of completion. If any materials or workmanship prove to be defective within one (1) year, they shall be replaced or repaired by the CONTRACTOR at the CONTRACTOR’s expense.

1.5 WORK SCHEDULE

- A. Within ten (10) days of notification of award of the contract, the Contractor shall submit to the Owner a detailed schedule showing dates when each work task is planned to begin and end.

- B. The Contractor shall schedule a pre-construction conference with representatives of the Owner prior to the start of any work on the tank.

1.6 MEASUREMENTS AND PAYMENTS

- A. For those items to be paid on a unit price basis, submit measurements for work complete with each requisition for payment.
- B. Before submitting measurements for unit price items, obtain verification from the owner's site representative of measurements performed by the Contractor.

1.7 CONSTRUCTION METHODS, MEANS AND SAFETY

- A. The Contractor shall be responsible for all construction methods and means.
- B. The Contractor shall be responsible for safety at the job site and shall comply with OSHA and Washington State requirements for scaffolding, rigging, other means of access, and protection of contractor personnel and authorized representatives of the Owner when at the site.

1.8 SERVICES PROVIDED BY THE OWNER

- A. The Owner will provide to the Contractor, without charge, water for construction operations.

1.9 TEMPORARY FACILITIES PROVIDED BY THE CONTRACTOR

- A. Temporary Light and Power: Furnish temporary light and power, complete with wiring, lamps and similar equipment as required to adequately light all work areas and with sufficient power capacity to meet the reasonable needs of all subcontractors. Make all necessary arrangements with the local electric company for temporary electric service, if required, and pay all expenses in connection therewith.
- B. Furnish all necessary tools, compressed air and hoses for water hook-ups at the location on the site where the water will be made available by the Owner.

PART 2 MATERIALS

2.1 CONCRETE RESTORATION

- A. Patching material: Euco Repair V100, Tammspatch II and Tamms Structural Mortar by Euclid Chemical Company or other approved equal.
- B. Material: Wet or dry mix in accordance with AWWA D110, ACI 301 & 506R or other approved equal.

- C. Anti-corrosion Reinforcing Primer: ECB by Conproco, Dural Prep AC by Tamms, or other approved equal.
- D. Replacement Reinforcement Anchors: ¼ in. x 1 ½ in. stainless steel expansion anchors or stainless steel concrete anchor screws as manufactured by the Powers Fasteners, Brewster, NY 10509, WEJ-IT, Tulsa, OK 74152, Hilti, Tulsa, OK 74121, Tapcon, or other approved equal.

2.2 POLYURETHANE GROUT INJECTION

- A. Injection Grout
 - 1. Hydro Active Flex LV by deNeef Construction Chemicals, Inc., Waller, TX.
 - 2. SikaFix HH LV by Sika Corporation, Inc., Lyndhurst, NJ.
 - 3. AV-202 Multigrout by Avanti International, Webster, TX.
 - 4. Or equivalent.

2.3 EXTERIOR TANK CLEANING AND ARCHITECTURAL COATING

- A. Exterior Tank Coating
 - 1. The base coat and the topcoat shall be TAMMSCOAT as manufactured by Euclid Chemical Company or approved equal.
 - 2. Color shall be as selected by the Owner.
- B. Polyurethane Joint Sealant
 - 1. Eucolastic 1NS as manufactured by Euclid Chemical Company, Cleveland, OH or approved equal.

2.4 INTERIOR ELASTOMERIC COATING

- A. Coating material shall be C.I.M. 1061, a high solids, two component liquid, cold applied, asphalt extended urethane elastomer that cures to a durable abrasion resistant film and forms a flexible, impermeable barrier to water, as manufactured by C.I.M. Industries Inc., or approved equal.
 - 1. Coating material shall comply with NSF61 criteria for direct contact with potable water.
 - 2. Minimum thickness: 60 mils. wet film / 55 mils. dry film
 - 3. Maximum coverage: 26 sq. ft. per gal.

4. Solids by volume: 88 percent
 5. Volatile Organic Compounds (VOC): 0.75 pounds per gallon
 6. Elongation: 350 percent
- B. Patching material for treatment of cracks shall be trowel grade C.I.M. 1000 Trowel Grade. Liquid applied, chemical and corrosion resistant urethane elastomer, chemically thickened to allow trowel application with minimum sag.
1. Potable Water Service: Classified for potable water contact in tanks, reservoirs, pipes, and joints in accordance with ANSI/NSF 61 up to 180 degrees F (82 degrees C).
 2. Solids by volume: 89 percent.
 3. Extension to Break, ASTM D412: 300 percent.
 4. Abrasion Resistance, Weight Loss, ASTM D4060: 1.2 mg.
 5. Adhesion to Concrete, Dry, Elcometer: 350 pounds per square inch.
- C. Primer shall be CIM EMT Epoxy Primer. Two-component, high solids, moisture tolerant epoxy primer.
1. Potable Water Service: Classified for potable water contact in tanks, reservoirs, pipes, and joints in accordance with ANSI/NSF 61.
 2. Solids by Volume: 89 percent mixed.
 3. Volatile Organic Compounds (VOC): 2.0 pounds per gallon (240 g/L).
- D. Material for reinforcing coating material applied to floor and column footings shall be C.I.M Flexible Stitchbonded Polyester Scrim.
1. Weight: 3 oz. per square yard
 2. Tensile Strength: 57.1 lbs. average (ASTM D 1682)
 3. Elongation: 61.65% average (ASTM D 1682)
 4. Mullen Burst Strength: 176.8 lbs. (ASTM D 3786)
 5. Trapezoidal Tear Strength: 16.1 lbs. average (ASTM D1117)
- E. Bonding agent shall be C.I.M VOC Compliant Bonding Agent, an organosilane compound dispersed in acetone.

1. Potable Water Service: Classified for potable water contact in tanks, reservoirs, pipes, and joints in accordance with ANSI/NSF 61.
2. Solids by Volume: Less than 1 percent.
3. Volatile Organic Compounds (VOC): 0 pounds per gallon (0 g/L).

2.5 CHLORINATION AND DISINFECTION

- A. Calcium Hypochlorite granules or crushed tablets
- B. Sodium Hypochlorite

PART 3 EXECUTION

3.1 CONCRETE RESTORATION

- A. Removal of Unsound / Concrete
 1. Remove loose and unsound concrete with appropriate chipping hammer to sound shotcrete with a minimum depth of 3/8 in. over the complete repair area, except do not cut any sound (substantially uncorroded) mesh reinforcing.
- B. Surface Preparation: Clean the surface by removing any dust, unsound or contaminated material, laitance, and corrosion deposits. Clean loose corrosion deposits from exposed reinforcing. Where chipping is not required to remove unsound material, roughen the surface and remove any laitance by light scrubbing. High-pressure wash with clean water, at a minimum pressure of 3,500 psi, prior to priming exposed reinforcing and substrate.
- C. Prime exposed existing reinforcing steel by applying one full coat of approved priming material. Allow to dry before applying patching. If any doubt exists about having achieved an unbroken coating, a second application shall be made and, again, allowed to dry before applying patching.
- D. Prime substrate after it is saturated surface dry (i.e.: thoroughly soaked with clean water and any excess water removed) with a slurry of the repair mortar in accordance with the manufacturer's directions. Using a stiff mason's brush, the slurry shall be scrubbed into the substrate where access is not impeded by new wire mesh reinforcing. The repair mortar shall be installed as soon as the slurry becomes tacky and before it dries.
- E. Mix patching mortar in strict accordance with manufacturer's directions. Use only material from original bags and containers.

- F. Application of patching mortar.
 - 1. Exposed steel reinforcing bars and welded wire fabric shall be firmly secured to avoid movement during the application process, as this will affect mortar compaction, build and bond.
 - 2. Apply the patching mortar to the prepared substrate by gloved hand or trowel. First, work a thin layer of the mortar into the slurry and then build the mortar onto this layer. Thoroughly compact the mortar onto the primed substrate and around the exposed reinforcement.
 - 3. Apply the patching mortar in strict accordance with the manufacturer's directions.
 - 4. If sagging occurs during applications, the patching mortar shall be completely removed and reapplied at a reduced thickness onto the correctly re-primed substrate.
- G. Finish the patching mortar by striking off with a straight edge and closing with a steel float. Finish of the shotcrete surface shall be a nozzle or gun finish. The completed surface shall not be overworked.
- H. Low temperature conditions: In cold weather, normal precautions for winter when working with cementitious materials shall be adopted. The material shall not be applied when the substrate and/or air temperature is 45°F (7°C) and falling. At 45°F (7°C) static temperature or at 45°F (7°C) and rising, the application may proceed. Do not apply if the temperature is expected to fall below 45°F (7°C) within 24 hours of application. Comply with manufacturer's directions for cold weather applications.
- I. High temperature conditions at ambient temperatures about 80°F (26°C), the materials shall be stored in the shade. Comply with manufacturer's directions for hot weather applications.
- J. Water cure finished surfaces of patches using fine mist spray or wet burlap against surface for a minimum of seven (7) days after initial set of patch material.
- K. Cure finished surfaces of interior patches by method acceptable to owner.
- L. Store all materials in cool, dry conditions in the original unopened bags or cans, and in strict accordance with manufacturer's directions. Do not use materials that have been stored for periods longer than the manufacturer's recommended shelf life.

3.2 POLYURETHANE GROUT INJECTION

- A. General

1. All cracks or joints exhibiting any form of leakage (efflorescence, dampness, weeping, or flowing) shall be sealed to eliminate liquid infiltration through the cracks or joints as identified by the Engineer. This includes leaks that develop after completion of a portion or all of the grouting.
- B. Injection Equipment
1. The pumps used for pressure water and grout injection shall be capable of providing pressures at the injection gun or nozzle of up to 1000 psig, and the gun shall be fitted with a gauge for measuring the injection pressure. Check valves shall be placed in the hoses at the proper locations to prevent backflow (a reversal in the direction of flow) and unintentional formations of foam or gel. Follow manufacturer's current printed recommendation for equipment utilized for addition of accelerator.
- C. Surface Preparation
1. Use suitable tools and equipment to remove any and all deleterious materials from within cracks and joints to be treated including, but not limited to, coatings/resurfacers, mold, mildew, dirt, grease and efflorescence in order to expose the full length of the crack or joint.
- D. Injection Grout Procedures
1. Drill 5/8-in diameter holes around the leak's exit path starting at the bottom of the leak, crack or joint and continuing upward. Placement of holes will require the experience and discretion of the grouters and shall be subject to the approval of the Engineer.
 2. Holes shall be drilled directly into leak path or at a 45 degree angle to intersect cracks or joints in the concrete by starting drill holes 2 – 6 – in away from leaking cracks or joints and drilling sufficiently deep to intersect the leak path.
 3. Set and tighten mechanical packers in the holes.
 4. Pump water only through the packers to determine if communication has been achieved between packers and crack or joint.
 5. Pump the grout at approximately 50 to 100 psig using a staged or stepped grouting procedure by pumping grout into a packer and closely watching the response signs at the leak area. Higher pressures shall only be used when cracks are very tight or when injecting deep (10-in to 12-in) into the holes in the concrete. Continue to pump from packer to packer allowing approximately 2 to 5 minutes for gel time for the grout until gas bubbles are pushed out the leak's exit path followed by the flow of liquid grout and then foam. When foaming occurs, pump more grout through each packer around the leak and wait until the leak is fully sealed (5 to 30 minutes

depending on temperature). If liquid grout flow continues out a leak's exit for more than approximately 30 seconds, oakum shall be chinked or compressed into the leak to aid the grout's gel time as a dam.

6. If grout does not exude from the full length of the crack or joint, drill additional 5/8-in diameter holes, install packers and inject water and grout until complete sealing of the crack or joint has been achieved.
7. Once water cut-off has been achieved, the packers shall be completely removed. Holes shall be cleaned of residual polyurethane grout to a minimum depth of ¾", as measured from the face of the concrete surface, and filled with concrete repair material per Section 2.01.

3.3 EXTERIOR TANK CLEANING AND ARCHITECTURAL COATING

A. High Pressure Water Washing & Surface Preparation

1. High-pressure wash exterior surfaces of dome, dome ring, and tank wall to remove all foreign matter, efflorescence, dust, dirt, laitance or other surface contaminants. Minimum water pressure shall be 3,000 psi and the maximum water pressure shall be 5,000 psi.
2. After completion of the high pressure washing, low-pressure wash exterior surface as required with a 5% chlorine solution and thoroughly rinse with clean water to kill any algae, fungus or other surface contaminants.
3. Restore exterior wall surface, as required, with high strength patching material to provide a sound surface for the application of the exterior tank coating.
4. Detail and fill any dome shrinkage cracks less than 1/16" with Tammscoat manufactured by Euclid Chemical by working the material into the crack with a brush.
5. Detail any dome shrinkage cracks great than 1/16" with Eucolastic 1NS manufactured by Euclid with conventional caulking equipment and striking the material flush with the surrounding surface. Crack detailing products can be applied over the existing coating.

B. Mixing and Application of Exterior Tank Coating

1. Mix and apply the coating in strict accordance with the manufacturer's directions.
2. Do not apply coating when the temperature is below 45°F, or when the temperature is expected to fall below 45°F within 24 hours after completing application.

3.4 INTERIOR CLEANING

- A. High Pressure Water Washing & Surface Preparation: High-pressure wash interior surfaces of the tank wall and underside of the tank dome to remove all foreign matter, dust, dirt, laitance or other surface contaminants. Minimum water pressure shall be 3,000 psi and the maximum water pressure shall be 5,000 psi.
- B. Sediment Removal: Remove all wash water and sediment from the tank interior and dispose of onsite as directed by the owner.

3.5 INTERIOR CONCRETE EPOXY COATING

- A. Inspection and Identify Limits of Work
 - 1. Inspect all interior wall surfaces and identify all areas where cracks are present, and the application of the waterproof epoxy coating is recommended.
 - 2. Review the results of the inspection with the Engineer and confirm the limits of the coating application.
- B. Surface Preparation
 - 1. Prepare all surfaces where the epoxy coating is to be applied by high pressure hydro blasting or abrasive blasting to obtain the surface profile required by the manufacturer, CSP 2-4.
 - 2. Interior surface of tank wall shall be dry and have a minimum temperature of at least 5°F above the dew point at time of application of coating.
- C. Application of Epoxy Interior Coating
 - 1. Apply and cure the specified epoxy coat in accordance with the manufacturers recommendations.
 - 2. Fully cure the coating as required by the manufacturer
 - 3. Use only factory-trained applicators in field crew.

3.6 VOLATILE ORGANIC COMPOUNDS TESTING

D. Testing Requirements

Following coating, the tank shall be tested using the volatile organic soak test. Conduct the soak test as follows:

- 1. Provide the Material Safety Data Sheet (MSDS) from the manufacturer for the coating to be used to the Owner. The MSDS lists all organic solvents used in the

coating and should be used to determine which organic chemicals should be sampled for.

2. Following the curing period, the tank must be filled and allowed to soak for five days. At the end of the five-day soaking period, a sample of water shall be taken by Contractor and analyzed for volatile organic chemicals using the latest revision of EPA Method 524.2 or 502.2. In addition, analysis should be conducted for any other organic chemicals from the MSDS that are not analyzed as part of the 524.2 or 502.2 scan.
3. Provide test results to Owner. Upon receipt of the test results, the Owner will notify the Washington State Department of Health if any regulated chemical exceeds the applicable maximum contaminant level or if any unregulated chemical has been detected. The tank shall remain out of service until corrective action is taken and samples indicate that the water is of acceptable quality.
4. If test results indicate that all chemicals are within acceptable limits, the tank may be put into service. The Owner will submit test results to the Washington State Department of Health.

3.7 CHLORINATION AND DISINFECTION

- A. Disinfect tank by cleaning, chlorinating and testing in accordance with AWWA C652-92 Standard for Disinfection of Water-Storage Facilities.
 1. Obtain approval of proposed procedure for chlorination (either Method 2 or Method 3 given in C652) prior to start of procedure.
 2. Before the tank is returned to service sample and test for coliform organisms in accordance with the latest edition of "Standard Methods for the Examination of Water and Wastewater," APHA, AWWA, and WEF, Washington, D.C. using a state approved laboratory. Testing to be arranged and paid for by the Owner.
- B. Prior to disposal of heavily chlorinated water, consult with the Owner, to ascertain any special disposal requirements. Cost of de-chlorinated and disposal of water shall be borne by the Contractor.

END OF SECTION

DIVISION 10 - SPECIALTIES

**SECTION 10 14 10
IDENTIFYING DEVICES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section covers the work necessary to furnish and install, complete, identifying devices for the Project.
- B. Section includes:
 - 1. Process pipe color coding and labeling
 - 2. Process equipment nameplates
 - 3. Door and warning signs
- C. Related Sections:
 - 1. Section 40 05 13 - Common Work Results for Process Piping

1.2 STANDARDS, SPECIFICATIONS, AND CODES

- A. All safety related signs, markers, labeling, and symbols shall conform to the applicable provisions or codes of the Occupational Safety and Health Administration (OSHA), unless specifically modified hereinafter.
- B. All signage providing emergency information or general circulation directions, or identifies rooms for the physically handicapped, shall comply with the requirements of the latest edition of American National Standards Institute (ANSI A117.1).

1.3 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. Manufacturer's Data - Specifications and installation instructions for each type of sign required.
- C. Samples - Submit three full size samples of each color and finish of pipe labeling, process equipment nameplates, and warning signs with sample letters.
 - 1. Engineer's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

2. Submit samples of any other special identifying or signing provided for elsewhere in this specification.

PART 2 PRODUCTS

2.1 PIPE LABELING AND COLORS

- A. Unless noted otherwise on the Drawings or specified differently hereinafter, pipe labeling and colors shall conform to the following schedule:

<u>Service</u>	<u>Symbol (label)</u>	<u>Symbol Color (label)</u>	<u>Pipe Color</u>
Potable Water/Well Water	PW	White	Blue
Domestic Water (Cold/Hot)	--	White	Blue
Backwash Waste	WST	Black	Light Brown
Sanitary Sewer	SS	White	Brown
Chlorine Solution	CL	Black	Yellow
Fluoride Solution	FL	White	Purple
Drains	D	White	Gray
Vents	V	Black	Green
Misc. Piping	As directed by the Engineer	As directed by the Engineer	As directed by the Engineer

- B. Pipe identification labels and flow direction arrows shall consist of lettering and symbols applied over the pipe base color.
- C. Coating systems and surface preparation requirements used in color coding piping and lettering and flow arrows shall be as specified in Section 09 90 00, Painting and Coating.

2.2 PROCESS EQUIPMENT NAMEPLATES

- A. Nameplates shall be used to identify all process equipment including but not limited to pumps, chlorinators, control panels, and any other equipment requiring identification as directed by the Engineer.
- B. Fabricated from 1/16-inch-thick satin-surfaced Setonply, all edges beveled neatly.
- C. Furnish with drilled holes for mounting to the appropriate equipment or nearest adjacent surface. As an alternative, acceptable adhesive attachment methods may be used if approved by the Engineer.

- D. Nameplate background color, lettering color, and wording shall be as directed by the Engineer and approved by the Owner.
- E. Minimum Size: 4-inch x 1-1/2-inch.
- F. Manufacturer: Seton Nameplate Company, New Haven, CT, Style 2060-40 or equal.

2.3 SAFETY SIGNS

- A. Unless otherwise noted in the Safety Sign Schedule or on the Drawings, all safety signs mounted on doors or walls shall be enamel painted on semi-rigid butyrate, minimum 60 mils thickness.
- B. The corners shall be rounded with drilled holes in corners with grommets. The legend or background shall be preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability. Background color shall be manufacturer standard, except where otherwise required by the Contract Documents, local code or compliance with OSHA or NFPA requirements.
- C. Hazard warning signs based on NFPA 704 Hazard Identification System shall have color coded background in accordance with NFPA 704. Lettering shall be black. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- D. Safety Sign Schedule: furnish and install safety signs in accordance with the following schedule. This schedule shall not be construed as all inclusive. Install additional safety signs as required by local and federal codes.

1. Safety Sign Schedule:

Location(s)	Content
All interior and exterior hose bibs	"Non-Potable Water, Do Not Drink"
Standby Generator	Hazard Warning Sign as required per NFPA 704
Disinfection Room	Hazard Warning Sign as required per NFPA 704
Fluoridation Room	Hazard Warning Sign as required per NFPA 704

2.4 ROOM IDENTIFICATION SIGNS

- A. Install signs on the exterior of each door, acrylic with a polished finish and "stepped edge" border; wording and graphics subsurface printed; self-adhesive backing for installation on rough or textured surfaces.

- B. Interior room identification signs shall be melamine plastic suitable for raised lettering and Braille.
- C. Raised text, border and graphics shall be minimum 1/32 inch height. Provide international graphic symbology for all restrooms, shower rooms and multi-purpose rooms. Provide handicap symbol on all signs for rooms meeting handicap requirements. Grade 2 Braille.
- D. Finish shall be Eggshell. Color to be selected to match door color.
- E. All text shall be minimum 3/4 inch high.
- F. All signage shall comply with requirements of ADA.
- G. Signage provided on exterior doors shall be UV-resistant and specifically designed for exterior application.
- H. The following manufacturers are acceptable:
 - 1. Andco.
 - 2. ASE - Architectural Signs and Engraving.
 - 3. ASI Sign Systems.
 - 4. Best Manufacturing Co.
 - 5. Mohawk Engraving Co., Inc.
 - 6. Nelson-Harkins.
 - 7. Southwell.
 - 8. The Supersine Co.

2.5 EXTERIOR STATION SIGNS

- A. A bronze metal plaque shall be fabricated and mounted on the pump station exterior wall as shown with approximate dimensions of 16 inches high by 20 inches wide with back sides for epoxy mounting.
- B. Bronze plaque shall be free of pits, scale, sand holes, and other defects.
- C. Bronze used shall be 85-5-5-5 alloy.
- D. Hand tool and buff to provide clean, sharp figures with a bright finish.

- E. Provide border, background, texture, and finish as selected by the Engineer from Manufacturer’s standards.
- F. Protect the exposed surfaces with two coats clear non-yellowing lacquer.
- G. Provide hardware for concealed mounting on brick or CMU and mount at location as directed.
- H. Plaques shall be lettered as directed below. Obtain Engineer’s written approval of proof before fabricating.
- I. Plaque face shall have a 4-inch diameter rendition of the City of Port Orchard logo and the following lettering:



CITY OF PORT ORCHARD	
MCCORMICK WOODS PUMP STATION	
ENGINEER:	CONSOR
CONTRACTOR:	<to follow>
CONSTRUCTED:	<to follow>

PART 3 EXECUTION

3.1 PIPE LABELS AND FLOW DIRECTION ARROWS

- A. Location: At all connections to equipment, valves, branching fittings, at wall boundaries, and at intervals along the piping not greater than 5 feet on center with at least one label applied to each exposed horizontal and vertical run of pipe. Exposed piping not normally in view, such as behind ceilings and in closets and cabinets, shall also be labeled.
- B. Labels shall not be applied to the pipe until all pipe painting is complete or as approved by the Engineer.
- C. Application: By stencil over pipe base color. Base coat shall be cured, clean, and dry, prior to application of lettering.
- D. Lettering sizes for pipe labels shall be in accordance with ANSI A13.1, Table 3, and based upon the outside diameter of the pipe to which they are applied.
- E. Stripes on solution pipe shall be applied at intervals along the piping not greater than 5 feet on center with at least one stripe applied to each exposed horizontal and vertical run of pipe.

3.2 PROCESS EQUIPMENT NAMEPLATES

- A. Location: As directed by the Engineer.
- B. Mounting of process equipment nameplates shall be in accordance with the Manufacturer's instructions, and as directed by the Engineer.

3.3 PAINTED SIGNS

- A. Prepare and mask base material as required to provide clean surface for application of letters by stencil.
- B. Unless otherwise noted, color of letters shall be black.
- C. Paint Type: Semi-gloss alkyd enamel.

3.4 EXTERIOR STATION SIGNS

- A. Mount signs in the locations as directed by the Engineer.
- B. Secure signs using stainless steel fasteners.

END OF SECTION

**SECTION 10 44 16
FIRE EXTINGUISHERS**

PART 1 GENERAL

1.1 SUMMARY

- A. Work under this Section includes requirements to furnish and install, complete, portable fire extinguishers.
- B. Section includes:
 - 1. Fire extinguishers

1.2 SUBMITTALS

- A. Manufacturer, catalog data for each item including certifications and mounting information.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in Manufacturer's original, unopened protective packaging.
- B. Store and handle products in accordance with Manufacturer's instructions to protect them from damage.

PART 2 PRODUCTS

2.1 PORTABLE FIRE EXTINGUISHERS

- A. General
 - 1. All Extinguishers:
 - a. UL listing
 - b. Charged and ready for service
 - 2. Provide heavy-duty brackets with clip-together strap for wall mounting.
 - 3. Manufacturers: Products of the following, or equal, meeting these Specifications, may be used on this Project:
 - a. Amerex Corp.
 - b. Ansul Co.

- c. General Fire Extinguishing Corp.
 - d. J.L. Manufacturing Co.
 - e. Kiddle Belleville
 - f. Larsen's Manufacturing Co.
 - g. Modern Metal Products
 - h. Potter-Roemer, Inc.
 - i. W.D. Allen Manufacturing Co.
- B. Multi-Purpose Hand Extinguisher (F. Ext-1)
- 1. Tri-class dry chemical extinguishing agent.
 - 2. Pressurized, red enameled steel shell cylinder.
 - 3. Activated by top squeeze handle.
 - 4. Agent propelled through hose or opening at top of unit.
 - 5. For use on A, B, and C class fires.
 - 6. Minimum UL Rating: 4A:60B:C, 10-pound (4.5-kilogram) capacity.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Portable Fire Extinguishers
- 1. Provide at locations shown on Drawings.
 - 2. Mount hangers securely in position, in accordance with Manufacturer's recommendations.
 - 3. Top of Extinguisher: No more than 5 feet (1.5 meters) above the floor.

END OF SECTION

DIVISION 11 - EQUIPMENT

**SECTION 11 05 00
COMMON WORK RESULTS FOR EQUIPMENT**

PART 1 GENERAL

1.1 SUMMARY

- A. Provide all tools, supplies, materials, equipment, and all labor necessary for the furnishing, construction, installation, testing and operation of equipment and appurtenant work, complete and operable, all in accordance with the requirements of the Contract Documents.
- B. The provisions of this Section shall apply to all equipment specified and where referred to, except where otherwise specified or shown.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. All equipment, products and their installation shall be in accordance with the following standards, as applicable and as specified in each section of these specifications:
 - 1. ASTM International (ASTM)
 - 2. American Public Health Association (APHA)
 - 3. American National Standards Institute (ANSI)
 - 4. American Society of Mechanical Engineers (ASME)
 - 5. American Water Works Association (AWWA)
 - 6. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
 - 7. American Welding Society (AWS)
 - 8. National Fire Protection Association (NFPA)
 - 9. Federal Specifications (FS)
 - 10. National Electrical Manufacturers Association (NEMA)
 - 11. Manufacturer's published recommendations and specifications
 - 12. Oregon Occupational Safety and Health Division (OR-OSHA)
- B. The following standards have been referred to in this Section of the specifications.

1. ASTM International:
 - a. ASTM A48 - Specification for Gray Iron Castings.
 - b. ASTM A108 - Specification for Steel Bars, Carbon, Cold-Finished, Standard Quality.
2. American National Standards Institute (ANSI):
 - a. ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250, and 800.
 - b. ANSI B16.5 - Pipe Flanges and Flanged Fittings, Steel, Nickel Alloy, and Other Special Alloys.
 - c. ANSI B46.1 - Surface Texture.
 - d. ANSI S12.6 - Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors.
3. American Society Mechanical Engineers (ASME):
 - a. ANSI/ASME B1.20.1 - General Purpose Pipe Threads (Inch).
 - b. ANSI/ASME B31.1 - Power Piping.
4. American Water Works Association (AWWA):
 - a. AWWA C206 - Field Welding of Steel Water Pipe.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, Submittal Procedures.
- B. Shop Drawings:
 1. Furnish complete shop drawings for all equipment specified in the various sections, together with all piping, valves, and controls for review by the Engineer.
 2. Include calculations showing equipment anchorage forces and the capacities of the anchorage elements where required.
- C. Special Tools:
 1. Supply one complete set of special tools where necessary for the assembly, adjustment, and dismantling of the equipment.

2. Tools shall be suitable for professional work and manufactured by a recognized supplier of professional tools such as Snap On, Crescent, Stanley, or equal.
- D. Spare Parts:
1. Obtain and submit from the Manufacturer a list of suggested spare parts for each piece of equipment.
 2. Furnish the name, address, and telephone number of the nearest distributor for each piece of equipment.
 3. Spare parts shall be supplied when indicated in the appropriate equipment specification sections.
- E. Torsional and Lateral Vibration Analysis:
1. Where required by the individual equipment sections, provide a torsional and lateral vibration analysis of the equipment, in accordance with Section 01 33 00, Submittal Procedures.
 2. Equipment shall be designed and constructed such that the natural frequency of the drive train is avoided by a minimum of 25 percent throughout the entire operating range.
 3. Analysis shall be performed by a specialist experienced in this type of work and approved by the Engineer.
 - a. The specialist, or their assigned representative who shall similarly be experienced in this type of work and who shall be approved by the Engineer, shall visit the Site during startup and testing of the equipment to analyze and measure the amount of equipment vibration, certify that the operating frequency avoids the natural frequency by 25 percent, and make a written recommendation for keeping the vibration at a safe limit.

1.4 QUALITY ASSURANCE

- A. Demonstrate all equipment meets the specified performance requirements. Provide the services of an experienced, competent, and authorized service representative of the Manufacturer of each item of major equipment, who shall visit the Site to perform the following tasks:
1. Assist the Contractor in the installation of the equipment.
 2. Inspect, check, adjust if necessary, and approve the equipment installation.

3. Start-up and field-test the equipment for proper operation, efficiency, and capacity.
 4. Perform necessary field adjustments during the test period until the equipment installation and operation are satisfactory to the Engineer.
 5. Instruct the Owner's personnel in the operation and maintenance of the equipment. Instruction shall include step-by-step trouble shooting procedures with all necessary test equipment.
- B. The costs of all inspection, startup, testing, adjustment, and instruction work performed by said factory-trained representatives shall be borne by the Contractor. When available, the Owner's operating personnel will provide assistance in the field testing.
 - C. Tolerances and clearances shall be as shown on the shop drawings and shall be closely adhered to. Machine work shall in all cases be of high-grade workmanship and finish, with due consideration to the special nature or function of the parts.
 - D. The type of finish shall be the most suitable for the application and shall be in accordance with ANSI B46.1.
 - E. Unless otherwise noted, all equipment furnished shall have a record from the same manufacturer of at least 3 years successful, trouble-free operation in similar applications.

1.5 DELIVERY, HANDLING, AND STORAGE

- A. All equipment shall be boxed, crated, or otherwise protected from damage and moisture during shipment, handling, and storage.
- B. Each item of equipment shipped shall have a legible identifying mark corresponding to the equipment number shown or specified for the particular item.
- C. All equipment shall be protected from exposure to corrosion and shall be kept thoroughly dry at all times.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Hearing Protection:

1. At each high noise level location, where equipment produces noise exceeding 85 dBA at 3 feet or exceeding OSHA noise level requirements for operator safety, supply two pairs of high attenuation hearing protectors.
 2. Ear protectors shall meet the requirements of ANSI S12.6 and shall produce a noise level reduction of 25 dBA at a frequency of 500 Hz.
 3. Hearing protectors shall have fluid filled ear cushions and an adjustable, padded headband.
 4. Protectors shall be stored in a weatherproof, labeled, steel cabinet, furnished by the Contractor and mounted in an approved location near the noise producing equipment.
- B. Welding:
1. Unless otherwise specified or shown, all welding shall be by the metal arc method or gas-shielded arc method as described in the American Welding Society's "Welding Handbook" as supplemented by other pertinent standards of the AWS.
 2. Qualification of welders shall be in accordance with the AWS Standards governing same.
- C. Protective Coatings:
1. All equipment shall be painted or coated in accordance with Section 09 90 00, Painting and Coating, unless otherwise indicated.
 2. Non-ferrous metal and corrosion-resisting steel surfaces shall be coated with grease or lubricating oil.
 3. Coated surfaces shall be protected from abrasion or other damage during handling, testing, storing, assembly, and shipping.
- D. All equipment subject to vibration shall be provided with restrained spring type vibration isolators or pads per Manufacturer's written recommendations.
- E. Shop fabrication shall be performed in accordance with the Specifications and the Engineer-approved shop drawings.

2.2 EQUIPMENT SUPPORTS AND FOUNDATIONS

A. Design Loads:

1. All equipment supports, anchors, and restraint shall be adequately designed for static, dynamic, wind, and seismic loads.

2. The design horizontal seismic force shall be the greater of that noted in the general structural notes or as required by the governing building code (10 percent of gravity minimum).

B. Equipment foundations shall be as per Manufacturer's written recommendations.

C. All equipment shall be mounted as shown on the Manufacturer's standard details, unless otherwise shown or specified.

2.3 PIPE HANGERS, SUPPORTS, AND GUIDES

A. All pipe connections to equipment shall be supported, anchored, and guided to avoid stresses and loads on equipment flanges and equipment.

2.4 FLANGES AND PIPE THREADS

A. All flanges on equipment and appurtenances provided under this Section shall conform to ANSI B16.1, Class 125 or B16.5, Class 150, unless otherwise shown.

B. All pipe threads shall be in accordance with ANSI/ASME B1.20.1 and with requirements of Section 40 05 13, Common Work Results for Process Piping.

2.5 COUPLINGS

A. Flexible couplings shall be provided between the driver and the driven equipment to accommodate slight angular misalignment, parallel misalignment, end float, and to cushion shock loads. Where required for vertical shafts, three-piece spacer couplings or universal type couplings for extended shafts shall be installed.

B. The Contractor shall have the Equipment Manufacturer select or recommend the size and type of coupling required to suit each specific application.

C. Taper-lock bushings may be used to provide for easy installation and removal on shafts of various diameters.

D. Where universal type couplings are shown, they shall be equipped with grease fittings.

2.6 BEARINGS

A. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association (AFBMA).

B. All field-lubricated type bearings shall be equipped with a hydraulic grease fitting in an accessible location and shall have sufficient grease capacity in the bearing chamber.

C. All lubricated-for-life bearings shall be factory-lubricated with the Manufacturer's recommended grease to insure maximum bearing life and best performance.

- D. Except where otherwise specified or shown, all bearings shall have a minimum B-10 life expectancy of 5 years or 20,000 hours, whichever occurs first.
- E. Bearing housings shall be of cast iron or steel and bearing mounting arrangement shall be as specified or shown, or as recommended in the published standards of the Manufacturer. Split type housings may be used to facilitate installation, inspection, and disassembly.
- F. Sleeve type bearings shall have a Babbitt or bronze liner.

2.7 V-BELT DRIVES

- A. V-belts and sheaves shall be of the best commercial grade and shall conform to ANSI, MPTA and RMA standards.
- B. Unless otherwise specified, sheaves shall be machined from the finest quality gray cast iron.
- C. All sheaves shall be statically balanced. In applications where vibration is a problem, sheaves shall be dynamically balanced. Sheaves operating at belt speeds exceeding 6,500 feet per minute (fpm) may be required to be of special materials and construction.
- D. To facilitate installation and disassembly, sheaves shall be furnished complete with taper-lock or QD bushings as required.
- E. Finish bored sheaves shall be furnished complete with keyseat and set screws.
- F. Sliding motor bases shall be provided to adjust the tension of V-belts.

2.8 DRIVE GUARDS

- A. All power transmission, prime movers, machines, shaft extensions, and moving machine parts shall be guarded to conform with the OSHA Safety and Health Standards (29CFR1910) requirements.
- B. Guards shall be constructed of minimum 10-gauge expanded, flattened steel with smooth edges and corners, galvanized after fabrication and securely fastened.
- C. Where required for lubrication or maintenance, guards shall have hinged and latched access doors.

2.9 FLEXIBLE CONNECTORS

- A. Flexible connectors shall be installed in all piping connections to engines, blowers, compressors, and other vibrating equipment.

2.10 GASKETS AND PACKINGS

- A. Gaskets shall be in accordance with the requirements of Section 40 05 13, Common Work Results for Process Piping.
- B. Packing around valve stems and reciprocating shafts shall be of compressible material, compatible with the fluid being used. Chevron type "V" packing shall be Garlock No. 432, John Crane "Everseal" or equal.
- C. Packing around rotating shafts (other than valve stems) shall be "O" rings, stuffing boxes, or mechanical seals, as recommended by the Manufacturer and approved by the Engineer.

2.11 NAMEPLATES

- A. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location.
- B. Nameplates shall contain the Manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the machine performance ratings.

PART 3 EXECUTION

3.1 WELDING

- A. In assembly and during welding, the component parts shall be adequately clamped, supported, and restrained to minimize distortion and for control of dimensions.
- B. Weld reinforcement shall be as specified by the AWS code. Upon completion of welding, all weld splatter, flux, slag, and burrs left by attachments shall be removed.
- C. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions.
- D. All sharp corners of material to be painted or coated shall be ground to a minimum of 1/32-inch on the flat.

3.2 COUPLINGS

- A. The Contractor shall have the Equipment Manufacturer select or recommend the size and type of coupling required to suit each specific application.
- B. Installation shall be per Equipment Manufacturer's printed recommendations.

3.3 PACKAGED EQUIPMENT

- A. When any system is furnished as pre-packaged equipment, the Contractor shall coordinate all necessary space and structural requirements, clearances, utility connections, signals, and outputs with the Contractor's subcontractors.
- B. If the packaged system has any additional features other than specified, the Contractor shall coordinate such features and furnish all material and labor necessary for a complete installation, as required by the Manufacturer, at no additional cost to the Owner.

END OF SECTION

DIVISION 22 - PLUMBING

**SECTION 22 00 00
PLUMBING**

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes labor, materials, equipment, services, and incidentals required to install a complete, operable, and tested, plumbing system as specified herein and as shown on the Drawings. All materials and equipment shall be new and of the best quality. Work shall include, but not necessarily be limited to:
 - 1. Domestic water systems.
 - 2. Plumbing fixtures and trim.
 - 3. Laboratory piping.
 - 4. Testing.

1.2 SUBMITTALS

- A. Provide shop drawings and technical literature covering details of equipment, fixtures, and accessories furnished under this section.
- B. Provide list of recommended spare parts.

1.3 QUALITY ASSURANCE

- A. Codes:
 - 1. Comply with the rules and regulations of Authorities having jurisdiction over the work specified herein, including the 1991 Uniform Plumbing Code with local amendments.
 - 2. Where specifically indicated, fixtures shall be provided and installed in accordance with ANSI A117.1: "Specifications for Making Buildings and Facilities Accessible to, and usable by, the Physically Handicapped."
- B. Obtain Permits and inspections as required by the various codes.
- C. The Drawings shall be taken in a sense as diagrammatic. Size of pipes and general method of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that may be encountered.

PART 2 PRODUCTS

2.1 GENERAL

Equipment and materials shall conform to the standards and Manufacturer's serial numbers shown, or equal.

2.2 LABORATORY SINKS (EPOXY RESIN)

- A. Chemical and corrosion resistant epoxy resin material heat-formed into one-piece construction, having rounded corners and 1-1/2-inch drain outlet. Same material as work surfaces.
- B. Inside dimensions: 30 inches long x 24 inches wide x 12 inches deep.
- C. Acceptable manufacturers and products are:
 - 1. Hamilton Modified Epoxy 20L202
 - 2. Kewaunee Kemresin No. 1000 series
 - 3. Or equal.

2.3 SINK DRAIN ASSEMBLIES

Durcon Model No. So-3 outlet with No. AD-1 adapter, No. DT-3 trap and BH-6 overflow; R&G Sloane Manufacturing Company Model No. 7841 A outlet with No. 7218 adapter, No. 7225 P-trap, and No. 7842 overflow; or equal.

2.4 EMERGENCY EYEWASH AND SHOWER COMBINATION UNIT

Eyewash and shower assemblies shall be Haws model 8300, Western Drinking Fountain Company or equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install escutcheons secured to pipe with set-screw where pipes or tubing pass-through exposed walls or ceilings.
- B. Provide all fixtures with traps and vents unless otherwise indicated on the drawings.
- C. Unless indicated otherwise, all soil, waste and drain piping shall be sloped not less than 1/4-inch per foot downward in the direction of the flow.
- D. Provide dielectric unions or couplings at points of connection of ferrous to non-ferrous metal piping.

3.2 TEST AND INSPECTION

- A. Test the systems and arrange for inspection by the proper authorities.
- B. Water piping shall be hydraulically tested at 125 psig and demonstrated to be leak-free for a four-hour test period.
- C. Waste, drain, and vent piping shall be tested in conformance with the 1991 Uniform Plumbing Code with local amendments. Storm drain (rainwater) piping shall be tested similar to waste, drain, and vent piping.

- D. Disinfection of plumbing shall be done in accordance with AWWA C651 (see section 15050, Pipes Valves and Accessories).

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Work Included:

1. Pipe Hangers and Supports for Plumbing Piping and Equipment
2. Wall and Floor Sleeves
3. Building Attachments
4. Flashing
5. Miscellaneous Metal and Materials

B. Related Sections:

1. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.2 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

B. In addition, meet the following:

1. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.
2. Hanger spacing installation and attachment to meet all Manufacturer's requirements and MSS SP-58.
3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
4. Install piping per SMACNA's requirements.

1.3 SUBMITTALS

A. Submittals as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

1.4 QUALITY ASSURANCE

A. Quality assurance as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

1.5 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

1.6 PERFORMANCE REQUIREMENTS

- A. General - Provide pipe and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the Contractor is responsible for their design.
 - 2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
 - 1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
 - 2. Equipment and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- E. Provide seismic restraint hangers and supports for piping and equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
 - 1. Pipe Hangers/Supports:
 - a. B-Line Systems, Inc.
 - b. Anvil International

- c. HOLDRITE
 - d. Erico Co., Inc.
 - e. Snappitz Thermal Pipe Shield Manufacturing
 - f. Rilco Manufacturing Co. Inc.
 - g. Nelson-Olson Inc.
 - h. Or equal.
2. Channel Support Systems:
- a. B-Line Systems, Inc.
 - b. Anvil International, Anvit-Strut
 - c. Erico Hanger Co., Inc.; O-Strut Div.
 - d. Unistrut Corp.
 - e. HOLDRITE EZ-Strut Systems
 - f. Or equal.
3. Thermal-Hanger Shield Inserts:
- a. Erico Hanger Co., Inc.
 - b. Pipe Shields, Inc.
 - c. Rilco Manufacturing Co., Inc.
 - d. HOLDRITE Insulation Couplings
 - e. Or equal.
4. Freestanding Roof Supports:
- a. Erico Hanger Co., Inc.
 - b. Nelson-Olsen Inc.
 - c. B-Line
 - d. M. Fab
 - e. Or equal.
5. Pipe Alignment and Secondary Supports:

- a. HOLDRITE
 - b. Starquick
 - c. Or equal.
- B. Wall and Floor Sleeves:
- 1. Below Grade and High-Water Table Areas:
 - a. Modular Link Sealing System at Pipe Sleeves:
 - 1) Thunderline Corporation
 - 2) Or equal.
 - 2. Pre-Engineered Firestop Pipe Penetration Systems:
 - a. HOLDRITE HydroFlame
 - b. Proset
 - c. Or equal.
- C. Building Attachments:
- 1. Anchor-It
 - 2. Gunnebo Fastening Corp.
 - 3. ITW Ramset/Red Head
 - 4. Masterset Fastening Systems, Inc.
 - 5. Or equal.
- D. Flashing:
- 1. Fastenal
 - 2. Or equal.
- E. Miscellaneous Metal and Materials:
- 1. See Miscellaneous Metal and Materials article below.
 - 2. Powder-Actuated Fastener Systems:
 - a. Gunnebo Fastening Corp.
 - b. Hilti, Inc.

- c. ITW Ramset/Red Head.
- d. Masterset Fastening Systems, Inc.
- e. Or equal.

2.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:

1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance with Manufacturer's published product information.
2. Use only one type by one manufacturer for each piping service.
3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
4. Provide copper-plated hangers and supports for uninsulated copper pipingsystems.
5. Provide padded pipe hangers, clamps and supports for thermoplastic pipingsystem.
6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or equal.

B. Pipe Hangers, Guides and Channel Systems:

1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sightgap for visual inspection; to have same finish as hanger rods.
3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or equal. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surface to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
5. Pipe Guides:

- a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per Manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33; one side of channel to have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
- C. Pipe Saddles and Shields:
- 1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 - 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
- 1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
 - 2. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate.
 - 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
 - 5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 - 6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360-degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.

- E. Roller Hangers:
 - 1. Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
- F. Concrete Inserts:
 - 1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- G. Continuous Concrete Insert:
 - 1. Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- H. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- I. Below Ground:
 - 1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
 - 2. Rod: 5/8-inch stainless steel Type 316.
 - 3. Eyebolt: Stainless steel Type 316.
 - 4. Nuts and Washers: Stainless steel Type 316.
- J. Hangers for Pipe Size 2-inches and Smaller:
 - 1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.
- K. Hangers for Pipe Size 2-1/2-inches and Larger:
 - 1. Adjustable clevis type, UL listed, Type 1.
- L. Riser Clamps:
 - 1. Steel, UL listed. MSS Type 8.
- M. Plumbers Tape:
 - 1. Not permitted as pipe hangers or pipe straps.
- N. Pipe Alignment and Secondary Support Systems:
 - 1. Secondary Pipe supports for general applications (Non-Acoustical).

- a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
 - b. Supports may be used when sound and/or vibration transfer is not a concern.
2. Secondary pipe supports for sound and vibration attenuation (Acoustical).
- a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
 - b. Acoustical pipe supports will be manufactured and installed in compliance with International Organization for Standardization (ISO) 3822-1 with current amendments.
 - c. Supports will be used when sound and/or vibration transfer is a concern. Locations where acoustical supports will be provided and include but are not limited to partition walls between living units, tenant spaces, retail units, mechanical rooms, and lobbies.
 - d. Support Products:
 - 1) Support to Wall Brace and Wall Stud Penetrations: HOLDRITE #261, #262, #263, and #264, or equal.
 - 2) Pipe Wrap for Pipe Clamps and Channel-Mounted Pipe Clamps: HOLDRITE #270, or equal.
 - 3) Pipe Wrap for Pipe Hangers: HOLDRITE #271, #272-2, and #272-4, or equal.
 - 4) Drop-Ear Fitting Support: HOLDRITE #265, or equal.
 - 5) Floor Riser Isolation Pads: HOLDRITE #275-T, or equal.
 - 6) Floor Isolation Pads (General Applications): HOLDRITE #274, #275, #276, and #278, or equal.
- O. Freestanding Roof Pipe Supports:
- 1. Polyethylene high-density U.V. resistant quick "pipe" block with foam pad.
 - 2. Recommended installation is for pipe blocks to be freestanding.
 - 3. Piping 3-inches and larger mounted on block type supports.

2.3 WALL AND FLOOR SLEEVES

- A. Below Grade and High-Water Table Areas:

1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
 2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51, cement lined. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with Project's Structural Engineer. In areas with a high-water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.
- B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.
- D. Fabricated Accessories:
1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
 - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
 - b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.
 - c. Sleeve Sizes 7-inches and Larger: 14 gauge.
 - d. Fire-Rated Safing Material:
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.4 BUILDING ATTACHMENTS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system Manufacturer's recommendations or as modified by Project Structural Engineer. Provide anchor bolts suitable for cracked concrete.

- B. Anchor Bolts:
 - 1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 - 3. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.
- C. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- D. Powder-Actuated Drive Pin Fasteners:
 - 1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- F. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, non-corrosive, and non-gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.5 FLASHING

- A. Steel Flashing: 26-gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.
- D. Provide hot dipped galvanized components for items exposed to weather.

2.6 MISCELLANEOUS METAL AND MATERIALS

- A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings, and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the Project. The Contractor is responsible for their design.
 - 1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware and similar items.
- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or equal.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather.
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.
- I. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, non-corrosive, and non-gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Examination:

1. Verify building materials to have hangers and attachments affixed in accordance with hangers to be used. Provide supporting calculations.

B. Preparation:

1. Examine Drawings and coordinate for verification of exact locations of fire and smoke rated walls, partitions, floors, and other assemblies. Indicate, by shading and labeling on Record Drawings such locations and label as "1-Hour Wall," "2-Hour Fire/Smoke Barrier," and the like. Determine proper locations for piping penetrations. Set sleeves in place in new floors, walls or roofs prior to concrete pour or grouting.

- #### C. Install hangers, supports, anchors and sleeves after required building structural work has been completed in areas where the work is to be installed. Coordinate with Project Structural Engineer proper placement of inserts, anchors, and other building structural attachments.

3.2 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

A. Hangers and Supports:

1. Comply with MSS SP-58. Pipe Hanger and Support Installation: Install hangers, supports, clamps, and attachments as required to properly support piping from building structure. For horizontally hung grooved-end piping, provide a minimum of 2 hangers per pipe section.
2. Pipe Ring Diameters:
 - a. Uninsulated and Insulated Pipe, except where oversized pipe rings are specified: Ring inner diameter to suit pipe outer diameter.
 - b. Insulated Piping Where Oversized Pipe Rings are Specified and Vibration Isolating Sleeves: Ring inner diameter to suit outer diameter of insulation or sleeve.
3. Oversize Pipe Rings: Provide oversize pipe rings of 2-inch and larger size.
4. Pipe Support Brackets: Support pipe with pipe slides.
5. Steel Backing in Walls: Provide steel backing in walls to support fixtures and piping hung from steel stud walls.

6. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - a. Field assemble and install according to Manufacturer's written instructions.
7. Pipe Guides:
 - a. Install on continuous runs where pipe alignment must be maintained. Provide a minimum of two on each side of expansion joints, spaced per Manufacturer's recommendations for pipe size. Fasten guides to pipe structure. Any contact with chilled water pipe should not permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - b. Install approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Do not use as supports. Provide in addition to other required pipe hangers and supports.
8. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
 - a. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - b. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1
9. Group parallel runs of horizontal piping to be supported together on trapeze-type hangers.
10. 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.
11. Do not support piping from other piping.
12. Fire protection piping will be supported independently of other piping.
13. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated.
14. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
15. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchor, and to facilitate the action of expansion joints, expansion loops, expansion bends and similar units.

16. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
17. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping" is not exceeded.
18. Insulated Piping: (comply with the following)
 - a. Attach clamps and spacers to piping.
 - 1) Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - 2) Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - 3) Do not exceed pipe stress limits according to ASME B31.9.
 - b. Install MSS SP-58, Type 39 protection saddles, if insulation without a vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - c. Install MSS SP-58, Type 40 protective shields on cold piping having a vapor barrier. Shields to span arc of 180 degrees.
 - 1) Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 (DN100) and larger if pipe is installed on rollers.
 - d. Shield Dimensions for Pipe, not less than the following:
 - 1) NPS 1/4 to NPS 3-1/2 (DN8 to DN 90): 12-inches long and 0.048-inchthick.
 - 2) NPS 4 (DN100): 12-inches long and 0.06-inch thick.
 - 3) NPS 5 and NPS 6 (DN125 and DN150): 18-inches long and 0.06-inch thick.
 - 4) NPS 8 to NPS 14 (DN200 to DN350): 24-inches long and 0.075-inch thick.
 - 5) NPS 16 to NPS 24 (DN400 to DN600): 24-inches long and 0.105-inchthick.
 - e. Pipes NPS 8 (DN200) and Larger: Include wood inserts.
 - f. Insert Material: Length at least as long as protective shield.

g. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

19. Equipment Clearances: Do not route equipment or piping through electrical rooms, transformer vaults, elevator equipment rooms, IT rooms, MPOE rooms, or other electrical or electronic equipment spaces and enclosures and the like. Within equipment rooms, provide minimum 3-foot lateral clearance from all sides of electric switchgear panels. Do not route piping or equipment above any electric power or lighting panel, switchgear, or similar electric device. Coordinate with Electrical and coordinate exact equipment or pipe routing to provide proper clearance with such items.

20. Pipe supports and hanger spacing (pipe supported from structure or floor-supported) to meet the requirements of References and Standards Article in Part1 above.

B. Pipe Curb Assemblies:

1. Provide for piping and electrical conduit which penetrates the structural roof deck to service equipment above the roof level (i.e., piping, electrical power, and control wiring). Meet requirements of roof warranty.

2. Provide prefabricated units for roof membrane and insulation penetrations related to equipment. Coordinate with roofing system. Set supports on the structural deck. Do not set supports on insulation or roofing. Provide level supports by prefabricated pitch built into the curb.

3. Piping above roof to be supported with freestanding roof pipe supports unless detailed otherwise. At roofing applications, the adhesion mastic is to be specifically submitted to and approved by the Roofing System Manufacturer/installer to maintain the integrity of all warranties.

4. At concrete floors, install a polyurethane mastic to the support block and adhere in place.

C. Vertical Piping:

1. Support with U-clamps fastened to wall to hold piping away from wall unless otherwise approved.

2. Riser clamps to be directly under fitting or welded to pipe. Provide neoprene pads for all systems except natural gas.

3. Riser to be supported at each floor penetration.

4. Provide structural steel supports at the base of pipe risers. Size supports to carry forces exerted by piping system when in operation.

D. Adjusting and Painting:

1. Adjust hangers so as to distribute loads equally on attachments. Provide grout under supports to bring piping and equipment to proper level and elevations.
2. Prime paint ferrous nongalvanized hangers, accessories, and supplementary steel which are not factory painted.

3.3 WALL AND FLOOR SLEEVES

A. "Link-Seal" Pipe Sleeves: Install at slab on grade floor/below grade piping penetrations. Provide Manufacturer's sleeve appropriate to seal type for pre-cast penetrations (except for DWV piping at slab on grade). Provide Manufacturer's sleeve appropriate to seal type for pre-cast penetrations.

B. Fabricated Pipe Sleeves:

1. Provide either steel or sheet metal pipe sleeves accurately centered around pipe routes. Size such that piping and insulation, if any, will have free movement within the sleeve, including allowance for thermal expansion. Sleeve diameter to be determined by local seismic clearance requirement, and by waterproofing requirements.
2. Length: Equal to thickness of construction penetrated, except extend floor sleeves 1-inch above floor finish.
3. Provide temporary support of sleeves during placement in concrete and otherwork around sleeves. Provide temporary end closures to prevent concrete and other materials from entering pipe sleeves.
4. Seal each end airtight with a resilient nonhardening sealer, UL listed, and fire rated per ASTM 814.

3.4 BUILDING ATTACHMENTS

A. Install within concrete slabs or attach to structural steel or wood. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints and at changes in direction of piping.

B. Attachment to Wood Structure: Provide MSS Type 34 for attachment to wooden beam or approved attachment for a wood structure.

C. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to Manufacturer's written instructions.

- D. Install concrete inserts before concrete is placed; fasten insert secure to forms. Where concrete with compressive strength less than 2500 PSI is indicated, install reinforcing bars through openings at top in inserts.
- E. Install powder-actuated drive pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by Powder-Actuated Tool Manufacturer. Install fasteners according to Powder-Actuated Tool Manufacturer's operating manual. Test powder-actuated insert attachments with a minimum load of 100 pounds.
- F. Bolting: Provide bored, drilled, or reamed holes for bolting to miscellaneous structural metals, frames or for mounts or supports. Flame cut, punched, or hand sawn holes will not be accepted.
- G. Anchor Bolts:
 - 1. Install anchor bolts for mechanical equipment and piping as required. Tightly fit and clamp base-supported equipment anchor bolts at equipment support points. Provide locknuts where equipment and piping are hung.
 - 2. Anchor Bolts (Cast-In-Place): Embed anchor bolts in new cast-in-place concrete to anchor equipment. Install a pipe sleeve around the anchor bolt for adjustment of the top 1/3 of the bolt embedment; sizes and patterns to suit the installation conditions of the equipment to be anchored.
- H. Pipe Anchors: Provide anchors to fasten piping, which is subject to expansion and contraction, and adjacent to equipment to prevent loading high forces onto the equipment.
- I. Escutcheon Plates: Install around horizontal and vertical piping at visible penetrations through walls, partitions, floors, or ceilings, including penetrations through closets, through below ceiling corridor wall, and through equipment room walls and floors.
- J. Installation of metallic or plastic piping penetrations through non-fire-rated walls and partitions and through smoke-rated walls and partitions:
 - 1. Install fabricated pipe sleeve.
 - 2. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification with specified material.
 - 3. Seal each end airtight with a resilient nonhardening UL listed fire resistant ASTM 814 sealant.
- K. Piping Penetrations Through Fire-rated (1 to 3 hour) Assemblies:
 - 1. Select and install pre-engineered pipe penetration system in accordance with the UL listing and Manufacturer's recommendation.

2. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814. Use HOLDRITE HydroFlame or equal.
- L. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

3.5 FLASHING

- A. Flash and counterflash where piping passes through weather or waterproofed walls, floors, and roofs.
- B. Flash vent soil pipes with flashings per Division 01, General Requirements.
- C. Flash floor drains over finished areas and roof drains, 10-inches clear on sides, minimum 36-inches x 36-inches sheet size. See Division 01, General Requirements. Fasten flashing to drain with clamping device.
- D. Install built up fixtures (mop sinks, shower stalls, shower floors) with water sealing systems/membranes to meet Code and as prescribed by Division 01, General Requirements and Section 22 00 00, Plumbing. Meet all Code testing requirements. Provide drainage devices with appropriate flanges, clamps, etc. to meet these installation requirements and ensure a water-tight installation.

3.6 MISCELLANEOUS METAL AND MATERIALS

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installation of anchorages, such as concrete inserts, sleeves, anchor bolts and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project Site.
- B. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing miscellaneous metal fabrications to in-place construction; including, threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required. Avoid cutting concrete reinforcing when drilling for inserts. Reference structural drawings and reinforcing shop drawings and determine locations of stirrups prior to drilling into concrete.
- C. Cutting, Fitting and Placement: Perform cutting, drilling, and fitting required for installation of miscellaneous metal fabrications. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete masonry or similar construction.

- D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- E. Setting Loose Plates: Clean concrete and masonry bearing surfaces of any bond reducing materials and roughen to improve bond to surfaces. Clean bottom surface of bearing plates.
 - 1. Set loose leveling and bearing plates on wedges or other adjustable devices. After the bearing members have been positioned and plumbed, tighten the anchor bolts. Do not remove wedges or shims, but if protruding, cut-off flush with edge of the bearing plate before packing with grout. Use metallic non-shrink grout in concealed locations where not exposed to moisture; use non-metallic non-shrink grout in exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
- F. Fabrication:
 - 1. General: Verify dimensions prior to fabrication. Form metal items to accurate sizes and configurations as indicated on Drawings and otherwise required for proper installation; make with lines straight and angles sharp, clean, and true; drill, countersink, tap, and otherwise prepare items for connections with work of other trades, as required. Fabricate to detail of structural shapes, plates, and bars; weld joints where practicable; provide bolts and other connection devices required. Include anchorages; clip angles, sleeves, anchor plates and similar devices. Hot dip galvanize after fabrication items installed in exterior locations. Set accurately in position as required and anchor securely to building construction. Construct items with joints formed for strength and rigidity, accurately machining for proper fit; where exposed to weather, form to exclude water.
 - 2. Finishes:
 - a. Ferrous Metal: After fabrication, but before erection, clean surfaces by mechanical or chemical methods to remove rust, scale, oil, corrosion, or other substances detrimental to bonding of subsequently applied protective coatings. For metal items exposed to weather or moisture, galvanize in manner to obtain G90 zinc coating in accordance with ASTM A123. Provide other non-galvanized ferrous metal with 1 coat of approved rust-resisting paint primer, in manner to obtain not less than 1.0 mil dry film thickness. Touch-up damaged areas with primer of same material before installation. Apply zinc coatings and paint primers uniformly and smoothly; leave ready for finish painting as specified elsewhere.
 - b. Metal in contact with Concrete, Masonry and Other Dissimilar Materials:

- 1) Where metal items are to be erected in contact with dissimilar materials, provide contact surfaces with coating of an approved zinc-chromate primer in manner to obtain not less than 1.0 mil dry film thickness, in addition to other coatings specified in these specifications.
 - c. For Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and apply galvanizing repair paint to comply with ASTM A780.
- G. Metal Fabrication:
1. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports.
 2. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.
 3. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of weld and methods used in correcting welding work, and with the following:
 - a. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - b. Obtain fusion without undercut or overlap.
 - c. Remove welding flux immediately.
 - d. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.
 4. Provide hot dipped galvanized components for items exposed to weather.

END OF SECTION

**SECTION 22 07 00
PLUMBING INSULATION**

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Plumbing piping insulation, jackets, and accessories.
2. Plumbing equipment insulation, jackets, and accessories.

B. Related Sections:

1. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
2. Section 09 90 00 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.2 REFERENCES

A. ASTM International:

1. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
2. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
3. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
4. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
6. ASTM C450 - Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
7. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
8. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
9. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
10. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
11. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.

12. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
13. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
14. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
15. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
16. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
17. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
18. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
19. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
20. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Samples: Submit two samples of representative size illustrating each insulation type.
- D. Manufacturer's Installation Instructions: Submit Manufacturer's published literature indicating proper installation procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 450 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Perform Work in accordance with City of Port Orchard Public Work's standard.

1.5 QUALIFICATIONS

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

1.6 PRE-INSTALLATION MEETINGS

- A. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with Manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by Manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year Manufacturer warranty for manmade fiber.

PART 2 PRODUCTS

2.1 PIPE INSULATION

- A. TYPE P-1: ASTM C547, molded glass fiber pipe insulation.
 - 1. Thermal Conductivity: 0.23 at 75 degrees F.
 - 2. Operating Temperature Range: 0 to 850 degrees F.

3. Vapor Barrier Jacket: ASTM C1136, Type I, factory applied reinforced foil kraft with self-sealing adhesive joints.
 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- B. TYPE P-2: ASTM C547, molded glass fiber pipe insulation
1. Thermal Conductivity: 0.23 at 75 degrees F.
 2. Operating Temperature Range: 0 to 850 degrees F.

2.2 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Closed Cell Elastomeric Insulation Pipe Hanger: Polyurethane insert with aluminum single piece construction with self-adhesive closure. Thickness to match pipe insulation.
- F. Insulating Cement: ASTM C195; hydraulic setting on mineral wool.
- G. Adhesives: Compatible with insulation.

2.3 EQUIPMENT INSULATION

- A. TYPE E-1: ASTM C553; glass fiber, flexible or semi-rigid, noncombustible.
1. Thermal Conductivity: 0.24 at 75 degrees F.
 2. Operating Temperature Range: 0 to 450 degrees F.
 3. Density: 1.5 pound per cubic foot.
- B. TYPE E-2: ASTM C612; glass fiber, rigid board, noncombustible with factory applied reinforced.
1. Thermal Conductivity: 0.24 at 75 degrees F.
 2. Operating Temperature Range: 0 to 450 degrees F.
 3. Density: 3.0 pound per cubic foot.
 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- C. TYPE E-3: ASTM C612; semi-rigid, fibrous glass board noncombustible, end grain adhered to jacket.
1. Thermal Conductivity: 0.27 at 75 degrees F.

2. Operating Temperature Range: 0 to 650 degrees F.
 3. Vapor Barrier Jacket: ASTM C1136, Type II, factory applied reinforced foil kraft with self-sealing adhesive joints.
 4. Jacket Temperature Limit: minus 20 to 150 degrees F.
- D. TYPE E-4: ASTM C612; semi-rigid, fibrous glass board noncombustible.
1. Thermal Conductivity: 0.27 at 75 degrees F.
 2. Operating Temperature Range: 0 to 650 degrees F.

2.4 EQUIPMENT INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Adhesives: Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and Project conditions.
- B. Verify piping and equipment has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION – PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of assemblies with fire resistance rating greater than one hour.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.

3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Glass Fiber Board Insulation:
1. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
 2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
 3. Cover wire mesh or bands with cement to a thickness to remove surface irregularities.
- E. Extruded Polystyrene Insulation:
1. Wrap elbows and fitting with vapor retarder tape.
 2. Seal butt joints with vapor retarder tape.
- F. Hot Piping Systems less than 140 degrees F:
1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- G. Inserts and Shields:
1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- H. Insulation Terminating Points:
1. Coil Branch Piping 1 inch and Smaller: Terminate hot water piping at union upstream of the coil control valve.

2. Chilled Water Coil Branch Piping: Insulate chilled water piping and associated components up to coil connection.
 3. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- I. Closed Cell Elastomeric Insulation:
 1. Push insulation on to piping.
 2. Miter joints at elbows.
 3. Seal seams and butt joints with Manufacturer's recommended adhesive.
 4. When application requires multiple layers, apply with joints staggered.
 5. Insulate fittings and valves with insulation of like material and thickness as adjacent pipe.
 - J. High Temperature Pipe Insulation:
 1. Install in multiple layers to meet thickness scheduled.
 2. Attach each layer with bands. Secure first layer with bands before installing next layer.
 3. Stagger joints between layers.
 4. Finish with canvas jacket.
 - K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces less than 10 feet above finished floor: Finish with stainless steel jacket.
 - L. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with stainless steel jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.
 - M. Buried Piping: Insulate only where Insulation Manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
 - N. Heat Traced Piping Interior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer.
 - O. Heat Traced Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with stainless steel jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.

P. Prepare pipe insulation for finish painting. Refer to Section 09 90 00.

3.3 INSTALLATION - EQUIPMENT

A. Factory Insulated Equipment: Do not insulate.

B. Exposed Equipment: Locate insulation and cover seams in least visible locations.

C. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

D. Equipment Containing Fluids Below Ambient Temperature:

1. Insulate entire equipment surfaces.

2. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

3. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.

4. Finish insulation at supports, protrusions, and interruptions.

E. Equipment Containing Fluids 140 degrees F Or Less:

1. Do not insulate flanges and unions, but bevel and seal ends of insulation.

2. Install insulation with factory-applied or field applied jackets, with or without vapor barrier. Finish with glass cloth and adhesive.

3. Finish insulation at supports, protrusions, and interruptions.

F. Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with stainless steel jacket.

G. Equipment Located Exterior to Building: Install vapor barrier jacket or finish with glass mesh reinforced vapor barrier cement. Cover with stainless steel jacket with seams located on bottom side of horizontal equipment.

H. Cover glass fiber insulation with stainless steel jackets.

I. Nameplates and ASME Stamps: Bevel and seal insulation around; do not cover with insulation.

J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

K. Prepare equipment insulation for finish painting. Refer to Section 09 90 00.

3.4 SCHEDULES

A. Water Supply Services Piping Insulation Schedule:

1. Domestic Hot Water Supply and Recirculation:
 - a. Type: P-1.
 - b. Thickness:
 - 1) Pipe Size 1-1/4 Inches and Smaller: 0.5 inch.
 - 2) Pipe Size 1-1/2 Inches and Larger: 1.0 inch.
 2. Domestic Hot Water Supply and Recirculation Systems with Domestic Water Temperature Maintenance Cable:
 - a. Type: P-1.
 - b. Thickness:
 - 1) Pipe Size 1 Inch and Smaller: 1.0 inch.
 - 2) Pipe Size 1-1/4 Inches to 2 Inches: 1.5 inches.
 - 3) Pipe Size 2-1/2 Inches and Larger: 2.0 inches.
 3. Domestic Cold Water:
 - a. Type: P-1.
 - b. Thickness:
 - 1) Pipe Size 1-1/4 Inches and Smaller: 0.5 inch.
 - 2) Pipe Size 1-1/2 Inches and Larger: 1.0 inch.
- B. Equipment Insulation Schedule:
1. Domestic Hot Water Storage Tanks:
 - a. Type: E-1.
 - b. Thickness: 1.5 inch.

END OF SECTION

**SECTION 22 10 00
PLUMBING PIPING**

PART 1 GENERAL

1.1 SUMMARY

A. Work Included:

1. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Buried Within 5 feet of Building
2. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Above Grade
3. Water Piping, Buried Within 5-feet of Building
4. Hot and Cold Domestic Water Above Grade
5. Condensate Piping
6. Primer Piping
7. Chemical Resistant DWV Piping
8. Cleanouts

B. Related Sections:

1. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.2 REFERENCES AND STANDARDS

A. References and Standards as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

B. In addition, meet the following:

1. NSF 61, Annex G.
2. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
6. American Water Works Association (AWWA) for Valving Assembly Standards.

7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
8. American National Standards Institute (ANSI) for Piping Standards.
9. NFPA Standard 51B - "Fire Prevention in Use of Cutting and Welding Processes".
10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

1.3 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

1.4 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

1.5 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing and Division 01, General Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. See component manufacturers listed in individual articles below.
- B. Uponor
- C. Cerro
- D. Tyler
- E. ADS
- F. Charlotte
- G. Elkhart
- H. Enfield
- I. Fusesel
- J. Gruvlok
- K. Spears

- L. Nibco
- M. Orion
- N. American-USA
- O. Sioux Chief
- P. Viega
- Q. Mueller
- R. Or equal.
- S. Cleanouts:
 - 1. J.R. Smith
 - 2. Zurn
 - 3. Wade
 - 4. Watts
 - 5. Sioux Chief
 - 6. Or equal.
- T. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
 - 1. Hilti
 - 2. Proset
 - 3. Or equal.

2.2 GENERAL

- A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
- B. Manufactured materials delivered, new to the Project Site and stored in their original containers.
- C. Product Marking: Furnish each item with legible markings indicating name brand and Manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

2.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Heavy Duty: ASTM C1540, Clamp-All Hi-Torq 125, Husky SD 4000, Mission HeavyWeight couplings.
- B. PVC Pipe: ASTM D 2665 IPS Schedule 40, **SOLID WALL** piping for drainage/waste and vent (DWV).
 - 1. Fittings: PVC DWV ASTM D2665.
 - 2. Joints: Solvent welded, with ASTM D2564 solvent cement, 2-step glue (primer and glue) is required.

2.4 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Standard Duty: ASTM C1277 or CISPI 310.
- B. Copper Tube: ASTM B 306, DWV
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.5 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Copper Pipe: ASTM B88, hard drawn, Type K (A).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: Brazed - BCuP2.
- B. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods, mega lug type.

2.6 HOT AND COLD DOMESTIC WATER ABOVE GRADE

- A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Brazed BCuP2.
- B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18 copper.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
- C. Copper Tube: Water pressures up to 250 PSI gauge. ASTM B 88 (ASTM BA 88m), Type K (A), Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Brazed BCuP2.
- D. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn.
 - 1. Fittings: ASME B16.22, wrought copper.
 - 2. Joints: Roll grooved mechanical coupling. ASTM A536.

2.7 CONDENSATE PIPING

- A. Copper Tube: ASTM B 88 (ASTM B898M), Type K (A), L (B), or M (C).
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.
- B. Use chemical resistant piping for drainage of condensate from combustion fuel sources (such as condensing boilers and water heaters), as noted in this Section for area of application.
- C. CPVC (Chlorinated Poly Vinyl Chloride) Pipe and Fittings:
 - 1. Pipe and Fittings: Schedule 40, NSF-14, ASTM 439, IAPMO IS20-96, socket fittings, solvent weld.

2.8 PRIMER PIPING

- A. Above Ground: Type L hard-drawn copper tubing with wrought sweat fittings and soldered joints.

- B. Below Ground: Type L soft annealed copper tubing with wrought sweat fittings and brazed joints.
- C. Below Ground: Cross-linked polyethylene (PEX) and engineered plastic fittings.

2.9 CHEMICAL RESISTANT DWV PIPING

- A. High Silicon Alloy Cast Iron Pipe: At all locations and rated assemblies. 14.5 percent silicon content ASTM A518 and A861.
 - 1. Fittings: Matching high silicon alloy. Cast iron.
 - 2. Joints: Acid resistant jute and poured lead or mechanical stainless steel fitting with PTFE/PFA liners.
- B. Stainless Steel Pipe: Locations above grade. Austenitic 316 stainless steel.
 - 1. Fittings: 316 stainless steel push fit (hub/spigot)
- C. PVDF Pipe: At all locations and rated assemblies F1673.
 - 1. Fittings: PVDF.
 - 2. Joints: Socket thermal fusion ASTM 2657.
- D. Polypropylene - Fire Retardant Pipe: All locations except plenums and rated assemblies. Polypropylene, flame retardant. ASTM F1412.
 - 1. Fittings: Polypropylene.
 - 2. Joints: Electrical resistance fusion. ASTM 1290.

2.10 CLEANOUTS

- A. Locate cleanouts as shown on Drawings and as required by local code. Cleanout same size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.
- B. Types:
 - 1. Tile Floor Cleanouts: J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread, ABS plug and standard screws.
 - 2. Carpeted Floor Cleanout: J. R. Smith 4020-X with carpet clamping frame, round heavy-duty nickel bronze top, taper thread, ABS plug, carpet clamping device and standard screws.
 - 3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.

4. Parking, Drives and Concrete Floor Cleanouts (Heavy Load): J. R. Smith 4100 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
5. Wall Cleanout: J. R. Smith 4472-U, countersunk bronze taper thread plug, stainless steel shallow cover and vandal proof screws.
6. Outside Area Walks: J. R. Smith 4020-U with round heavy-duty nickel bronze top, taper thread, ABS plug and top secured with vandal proof screws. Install in 18- by 18- by 6-inch-deep concrete pad flush with grade.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

A. Underground Piping Systems:

1. Examination: Verify that excavations are to required grade, dry, and not over-excavated.
2. Perform necessary excavation and backfill required for installation of plumbing work. Repair piping or other work at no expense to Owner.
3. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock, or other approved material at no expense to Owner.
4. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of testing laboratory.
5. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (muck, peat), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose of site native excavation material. Adequate width of trench for proper installation of piping or conduit.
6. Support Foundations:
 - a. Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction, and disposal of excavated materials to conform to requirements contained in other Specification Sections or Drawings.

- b. Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
- c. Foundation Material: Where native material has been removed, place and compact necessary foundation material to form base for replacement of required thickness of bedding material.

	Class A		Class B	
	Min.	Max.	Min.	Max.
Material Passing 3/4-inch Square Opening	27	47	0	1

- d. Bedding Material: Full bed piping on sand, pea gravel, or 3/4-inch minus crushed rock. Place minimum 4-inch-deep layer of sand, pea gravel, or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide firm foundation.

7. Backfilling:

- a. Following installation and successful completion of required tests, backfill piping in lifts.
 - 1) In "Pipe Zone" place backfill material and compact in lifts not to exceed 6-inches in depth to height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
 - 2) Place and compact backfill above "Pipe Zone" in layers not to exceed 12 inches in depth.
- b. Backfill Material:
 - 1) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand, or pea gravel.
 - 2) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."

8. Compaction of Trench Backfill:

- a. Where compaction of trench backfill material is required, use one of following methods or combination thereof:
 - 1) Mechanical tamper,

- 2) Vibratory compactor, or
 - 3) Other approved methods appropriate to conditions encountered.
- b. Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.
- B. General Installation:
1. Work performed by experienced journeyman plumbers. No exceptions.
 2. Provide access panels for concealed valves, shock arrestors, trap primers and the like.
 3. Install pipes and pipe fittings in accordance with recognized industry practices and Manufacturer's recommendations.
 4. Align piping accurately at connections, within 3/32-inch misalignment tolerance. Comply with ANSI B31 Code for Pressure Piping.
 5. Locate piping runs, as indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details, and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, and other structural and permanent-enclosure elements of building. Limit clearance to 1/2-inch where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1-inch clearance outside insulation. Whenever possible in finished and occupied spaces, conceal piping from view by locating it in column enclosures, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as indicated.
 - a. Do not run piping through transformer vaults, telephone, elevator, electrical or electronic equipment spaces or enclosures unless indicated on Drawings.
 - b. Concealed Piping Above Suspended Ceiling: Plan and coordinate to avoid interferences; install to maintain suspended ceiling heights shown on Architectural Drawings. Allow sufficient space above removable ceiling panels for panel removal. Locate piping so that valves are visible and accessible within 24-inches horizontally and vertically from point of access to the ceiling space. Provide plenum rated materials for ceiling spaces which are being used as plenums.

- c. Exposed Work: Run pipes parallel to the closest wall unless otherwise shown on Drawings; maintain maximum headroom; avoid light fixtures.
- d. Insulation Space Allowance: In piping work, allow space for pipe insulation and jackets. If interferences occur, move the piping to accommodate insulation thickness specified.
- e. Pipe Lengths: Do not use short lengths or nipples at locations where a full length of pipe will fit.
- f. Alignment Prior to Supporting and Anchoring: Place piping in proper alignment and position prior to connection to anchors, expansion loops, and equipment. Furnish jacking devices, temporary steel structural members, and assembled structures as necessary. Remove temporary equipment and structures supplied by Contractor at completion; such items to remain Contractor property.
- g. Valve and Equipment Connections: Piping not to place undue stress on flanged valves and equipment connections. Install mating flange faces true and parallel to each other and not requiring springing of piping for assembly. Pipe hangers and supports to carry the full weight of the pipe and fluid.
- h. Piping Leaks: Correct immediately; use new materials; leak-sealing compounds or peening not permitted.
- i. Pressure Ratings of Fittings, Valves, and Devices in Piping Systems: Pressure rating to be equal to, or greater than, the maximum working pressure of the system.
- j. Equipment Vents and Drains: Provide for coils and vessels which contain water. Provide isolation valves and outlet valves at piping high and low points to permit venting and draining of the vessel without venting and draining connected piping. Provide hose connections and caps on drain lines.
- k. Escutcheon Plates: Where exposed insulated and uninsulated piping passes through walls, floors, or ceilings; provide spring clip type. Provide plates on both sides of wall or floor.

C. Testing:

1. General:

- a. Provide temporary equipment for testing, including pumps, compressors, tanks, and gauges, as required. Test piping systems before insulation (if any) is installed and remove or disengage control devices before testing. Where necessary, test sections of each piping system independently, but do not use piping valves to isolate sections where test pressures exceed local valve

operating pressure rating. Fill each section with water, compressed air, or nitrogen and pressurize for the indicated pressure and time.

- b. Notify Architect and local Plumbing Inspector 2 days before tests.
- c. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- d. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- e. Send test results to Architect for review and approval and include in Operation and Maintenance Manual.

2. Testing of Pressurized Systems:

- a. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - b. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
3. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.

D. Corrosive Soil Conditions:

- 1. Wrap steel, iron, copper, or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's recommendations.
- 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- 3. Obtain and review Project soils report for verification of requirements concerning corrosive soils.

E. Protection:

- 1. Keep pipe openings closed by means of plugs or caps to prevent entrance of foreign matter. Protect piping, ductwork, fixtures, equipment, and apparatus against dirty water, chemical or mechanical damage both before and after installation. Restore

to its original condition or replace fixtures, equipment or apparatus damaged prior to final acceptance of work.

- F. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
 - 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- G. Cut piping squarely, free of rough edges and reamed to full bore. Insert piping fully into fittings.
- H. Provide joints of type indicated in each piping system.
- I. Thread pipe in accordance with ANSI/ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Remove excess cutting oil from piping prior to assembly. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by Pipe/Fitting Manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed.
- J. Sleeves:
 - 1. Pipe Sleeves:
 - a. Layout work in advance of pouring concrete, furnish, and set sleeves necessary to complete work.
 - b. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with non-shrinking grout or approved caulking compound (Except DWV Piping penetrating a concrete slab set on finish grade), provide "Link-Seal" sleeve sealing system for concrete/slab penetrations which are below grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements
 - c. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Provide modular link sealing system for concrete penetrations which are below grade. Caulk/seal piping passing through fire-rated assemblies per local AHJ requirements.
 - d. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Indicate penetrations on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Plumbing Drawings are diagrammatic. Offset piping as required to meet these limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written

approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.

2. Installation of metallic or plastic piping penetrations through non-fire-rated walls and partitions and through smoke-rated walls and partitions:
 - a. Install fabricated pipe sleeve.
 - b. After installation of sleeve and piping, tightly pack entire annular void between piping or piping insulation and sleeve identification.
 - c. Seal each end airtight with a resilient nonhardening seal per code.
3. Piping penetrations through fire-rated (1 to 3 hour) assemblies:
 - a. Select and install pre-engineered pipe penetration system in accordance with UL listing and Manufacturer's recommendation.
 - b. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E84.

3.2 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Excavation and Backfill:
 1. See 3.1.A. above.
- B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- C. Corrosive Soil Conditions:
 1. Wrap steel, iron, copper, or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's requirements.
 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- D. Cast-Iron Joints: Comply with Coupling Manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

- E. Sanitary and Storm Drainage:
 - 1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.
 - 2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60-inches.
 - 3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00, Plumbing Fixtures.
 - 4. Drains:
 - a. Install drains to suit finished floor. Install drains and components per Manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
 - 5. Wall Access Panel: Secure to wall framing and install so that flange forms a close-fitting joint with the finished wall surface.
 - 6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
 - 7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.
- F. Epoxy Coated Cast Iron Pipe and Fittings: Coat the piping terminus of any cut piping with an applied epoxy per Manufacturer's instructions. Denso Protal 7200 fast-cure epoxy repair coating.

3.3 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

- A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- B. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- C. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- D. Cast-Iron Joints: Comply with Coupling Manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.
- E. Sanitary and Storm Drainage:
1. Grade piping at a uniform pitch of 2 percent unless otherwise noted on Drawings.
 2. Indirect Waste or Drain Piping: Extend piping to discharge as shown on Drawings. Maintain minimum air gap. Provide traps on indirect waste or drain piping exceeding 60 inches.
 3. Fixture Carriers: Concealed fixture carriers for wall hung plumbing fixtures are specified in Section 22 40 00, Plumbing Fixtures.
 4. Drains:
 - a. Install drains to suit finished floor or roof surface. Install drains and components per Manufacturer's instructions. Slope flooring to floor drain or sink a minimum of 1/2-inch below finished floor elevation.
 - b. Install P-traps for hub drains, floor drains and floor sinks. P-traps to be of the same materials as soil and waste piping. Provide trap primer assembly for each drain or floor sink.
 5. Wall Access Panel: Secure to wall framing and install so that flange forms a close-fitting joint with the finished wall surface.
 6. Heat trace and insulate P-traps exposed to freezing conditions. Provide heat trace and electronic components to Division 26 for installation.
 7. Insulate horizontal branch lines from floor sinks, receptors and drains receiving cold discharge from equipment and appliances.

3.4 WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Excavation and Backfill:

1. See 3.1.A. above.

B. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.

C. Domestic Water:

1. "Piping" to include pipes, fittings, nipples, valves, and accessories connected thereto.
2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts, flues, conduits, and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.
3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
4. Use unions for piping connections to equipment.
5. Provide sufficient elbows, swings, and offsets to permit free expansion and contraction.
6. Use reducers or increasers. Use no bushings.
7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
9. Install exposed connections to equipment with special care, showing no toolmarks or threads at fittings and piping. No bowed or bent piping permitted.
10. Make ferrous to non-ferrous connections with dielectric fittings.
11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2 inches. Use no close nipples. Use only shoulder-type nipples.
12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-

bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.

13. Provide drain valves at base of risers and at low points on the system.

14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.

D. Sterilization of Domestic Water System:

1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.

2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.

3. Certification: Provide copy of domestic water chlorination certificate in each operation and maintenance manual.

4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

E. Buried Pre-Insulated Pipe Installation:

1. Installation and Testing: Install and test products in accordance with Manufacturer's installation instructions.

2. Manufacturer's installation instructions are to describe the following:

a. Storage and handling of pipes.

b. Trench preparation.

c. Installing pipe.

d. Installing accessories.

e. Installing fittings.

f. Building penetrations.

g. Field insulation kits.

h. Testing.

3.5 HOT AND COLD DOMESTIC WATER ABOVE GRADE

- A. Water Piping: Eliminate air from system. Fill and test at 125 PSIG or minimum 1-1/2 times static pressure at connection to serving utility main for period of two hours with no loss in pressure.
- B. Testing of Pressurized Systems:
 - 1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
 - 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.
- E. Solder copper tube and fitting joints with lead free nickel/silver bearing solder meeting ASTM Std. B-32, in accordance with IAPMO Is 3-93, ASTM B-828 and Copper Development Association recommended procedures. Clean joints by other than chemical means prior to assembly. "Shock" cooling is prohibited. Fluxes to be water soluble for copper and brass potable water applications, and meeting CDA standard test method 1.0 and ASTM B813-91. Apply solder until a full fillet is present around the joint. Do not apply solder and flux in such excessive quantities as to run down interior of pipe. Lead solder or corrosion flux not to be present at the jobsite.
- F. Braze copper tube and fitting socket with BCuP series filler metal without flux. Use listed brazing flux for joining of copper tube to brass or bronze fittings, meeting AWS FB3A or FB3C. "Shock" cooling is prohibited. A continuous fillet is to be visible around the completed joint. After cooling, thoroughly remove flux residue with warm water and a brush prior to testing. Do not use BCuP filler on copper alloys containing over 10 percent nickel. Cap or plug piping during construction to prevent entry of foreign material.
- G. Domestic Water:
 - 1. "Piping" to include pipes, fittings, nipples, valves, and accessories connected thereto.
 - 2. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical

ducts, flues, conduits, and work of other trades, and as close to ceiling or other construction as practical, free of unnecessary traps or bends.

3. Grade water supply piping for complete drainage of the system. Install hose bibbs at low points.
 4. Use unions for piping connections to equipment.
 5. Provide sufficient elbows, swings, and offsets to permit free expansion and contraction.
 6. Use reducers or increasers. Use no bushings.
 7. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageways.
 8. Cover, cap or otherwise protect open ends of piping during construction to prevent damage to threads or flanges and prevent entry of foreign matter. Disinfect and sterilize water supply piping as specified. Furnish written report on final water quality results.
 9. Install exposed connections to equipment with special care, showing no tool marks or threads at fittings and piping. No bowed or bent piping permitted.
 10. Make ferrous to non-ferrous connections with dielectric fittings.
 11. Use extra heavy pipe for nipples, where unthreaded portion is less than 1-1/2 inches. Use no close nipples. Use only shoulder-type nipples.
 12. Through-Wall Pipes: Type 'L' copper tubing for through-wall pipes which connect to exposed stops at wall surface. Anchor the pipes in the wall; attach pipe with U-bolts to steel back-up plates or steel angles anchored in the wall. Provide wrought copper elbow which securely anchors ears in wall at through-wall pipes.
 13. Provide drain valves at base of risers and at low points on the system.
 14. Backflow Preventers: Pipe relief to nearest drain. Slope at 2 percent.
- H. Sterilization of Domestic Water System:
1. General: Upon completion of tests and necessary replacements, thoroughly flush and disinfect domestic water piping.
 2. Method: After thoroughly flushing system with water to remove sediment, fill system with a solution containing 50 parts per million of chlorine for not less than 24 hours or 200 parts per million of chlorine for not less than 3 hours. After retention, drain, reflush and return system to service.

3. Certification: Provide copy of domestic water chlorination certificate in each operation and maintenance manual.
4. Provide water line disinfections performed by a licensed contractor with training in potable water line disinfections.

3.6 CONDENSATE PIPING

A. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:

1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

3.7 PRIMER PIPING

- #### A. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.

3.8 CHEMICAL RESISTANT DWV PIPING

A. Installation Guidelines for Polypropylene Pipe:

1. Install hangers and supports at intervals specified in the applicable Plumbing Code and as recommended by Pipe Manufacturer.
2. Support vertical piping at each floor and as specified in the applicable Plumbing Code.
3. Fusion Welding of Joints:
 - a. Install fittings and joints using socket-fusion, electrofusion, or butt-fusion as applicable for the fitting type. Make fusion-weld joints in accordance with the Pipe and Fitting Manufacturer's specifications and product standards.
 - b. Fusion-weld tooling, welding machines, and electrofusion devices as specified by the Pipe and Fittings Manufacturer.
 - c. Prior to joining, prepare the pipe and fittings in accordance with F 2389 and the Manufacturer's specifications.

- d. Joint preparation, setting and alignment, fusion process, cooling times and working pressure to be in accordance with Manufacturer's installation guidelines.
- B. Testing of Pressurized Systems:
 - 1. Test each pressurized piping system at 150 percent of operating pressure indicated, but not less than 125 PSIG test pressure.
 - 2. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 2 percent of test pressure.
- C. Test hot and cold domestic water piping systems upon completion of rough-in and before connection to fixtures at hydrostatic pressure of 125 PSIG.
- D. Corrosive Soil Conditions:
 - 1. Wrap steel, iron, copper, or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's requirements.
 - 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- E. Firestopping Penetrations in Fire-Rated Wall/Floor Assemblies:
 - 1. Provide proper sizing when providing sleeves or core-drilled holes to accommodate penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet requirements of ASTM E814.

3.9 CLEANOUTS

- A. Install in aboveground piping and building drain piping as indicated, as required by code; at each change in direction of piping greater than 135 degrees; at minimum intervals of 100-feet; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping. Select type to match adjacent building finish. Provide shop drawings to Architect to coordinate locations and types of cleanouts with Architect prior to installation.
- B. Drainage, Waste and Vent Piping: Test in accordance with governing plumbing code or as follows: Test drainage and venting systems, with necessary openings plugged, to permit system to be filled with water and subjected to water pressure of minimum of 5 PSI head. System to hold water without water level drop greater than 1/2 pipe diameter of largest nominal pipe size within 24-hour period. Test system in sections if minimum head cannot be maintained in each section. 5 PSI head to be minimum pressure at highest joint.
- C. Corrosive Soil Conditions:

1. Wrap steel, iron, copper, or other metal piping materials/fittings with Protecto Wrap 200, 30 mils or greater. Maintain a 1/2-inch overlap and install per Manufacturer's requirements.
 2. Provide epoxy coated cast iron pipe and fittings for drainage systems.
- D. Cast-Iron Joints: Comply with Coupling Manufacturer's Cast Iron Soil Pipe Institute Standards and installation instructions.

END OF SECTION

**SECTION 22 40 00
PLUMBING FIXTURES**

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Emergency Showers/Eyewash
 - 2. Floor Drains
 - 3. Hose Bibbs
 - 4. Cleanouts

1.2 SUBMITTALS

- A. Provide shop drawings and technical literature covering details of equipment, fixtures, and accessories furnished under this section.
- B. Provide list of recommended spare parts.

1.3 QUALITY ASSURANCE

- A. Codes:
 - 1. Comply with the rules and regulations of Authorities having jurisdiction over the work specified herein, including the 1991 Uniform Plumbing Code with local amendments.
 - 2. Where specifically indicated, fixtures shall be provided and installed in accordance with ANSI A117.1: "Specifications for Making Buildings and Facilities Accessible to, and usable by, the Physically Handicapped."
- B. Obtain Permits and inspections as required by the various codes.
- C. The Drawings shall be taken in a sense as diagrammatic. Size of pipes and general method of running them are shown, but it is not intended to show every offset and fitting nor every structural difficulty that may be encountered.
- D. In addition, meet the following:
 - 1. Comply with lead free (less than or equal to 0.25 percent) products in drinking water systems.

2. NSF 61, Annex G, Drinking Water System Components, Compliant.
3. ISO 9001, Quality Management Standard Certified.
4. IAPMO Low Lead Certification.
5. Provide fixtures, faucets, and accessories to meet barrier free requirements of the governing code with respect to plumbing fixtures provided for the physically handicapped.
6. Items approved for use by State of Washington.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Emergency Showers/Eyewash:

1. Bradley
2. Encon
3. Guardian
4. Haws
5. Speakman
6. Or equal.

B. Floor Drains:

1. Zurn
2. Smith
3. Wade
4. Watts

C. Hose Bibbs:

1. Chicago
2. JR Smith
3. Mifab

4. Wade
 5. Woodford
 6. Zurn
 7. Or equal.
- D. Cleanouts
1. Josam
 2. JR Smith
 3. Zurn

2.2 GENERAL PLUMBING FIXTURES

- A. Review substitution request requirements in Division 01, General Requirements.
- B. Reference Architectural Details for mounting height and location of fixtures.
- C. Provide factory fabricated fixtures of type, style and material indicated on the Drawings. For each type of fixture, provide Fixture Manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by Manufacturer, or required for complete installation. Where more than one type is indicated, selection is installer's option; but fixtures of same type must be furnished by a single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.
- D. Provide fixtures complete with fittings, supports, fastening devices, bolt caps, faucets, valves, traps, stops and appurtenances.
- E. Plumbing Fixture Thermostatic Mixing Valves:
1. Lavatories provide ASSE 1070 compliant mixing valves or multiple lavatories served by a single ASSE 1070 compliant mixing valve.
 2. Sinks serviced with a single ASSE 1070 mixing valve or multiple sinks served by a single ASSE 1070 mixing valve.
 3. Commercial kitchen hand sinks provide ASSE 1070 mixing valves.
 4. Janitor sinks or process/maintenance type sinks do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

- 5. Hot water hose bibbs do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

2.3 EMERGENCY SHOWERS/EYEWASH

- A. Provide emergency showers/eyewash products that are compliant with ANSI Z358.1, Standards for Emergency Eyewashes and Shower Equipment.
- B. Eyewash/facewash shall be positioned with nozzles not less than 33-inches and no greater than 45-inches from surface on which user stands and 6-inch minimum from wall or nearest obstruction.
- C. The eye/facewash shall be capable of delivering a minimum of 3-gpm.
- D. Eye/facewash and appurtenances shall be corrosion resistant material per manufacturer recommendations.

2.4 FLOOR DRAINS

- A. Floor drains shall be of cast iron with sediment buckets. Floor drains shall be sized to match the outlet piping as shown on the plans.
- B. All floor drains shall be vented per plumbing code.

2.5 HOSE BIBBS

- A. All hose bibbs in exposed locations subject to freezing shall be of the non-freeze type. Where hose bibbs are connected to a non-potable water supply, they shall be provided with plastic or stainless steel warning signs “DO NOT DRINK,” in clearly-legible letters and permanently attached at the hose bibb. Hose bibbs shall be provided with vacuum breakers as furnished by Crane Co.; American Standard; or equal.

2.6 CLEANOUTS

- A. All cleanouts shall be heavy plugs with tapered shoulders against caulked lead or heavy brass plugs. Where underground or concealed, cleanouts shall be brought to floor level and to accessible locations with access covers and frames.
- B. Manufacturer’s, or Equal: The following cleanouts, or equal, shall be furnished:

	<u>Josam</u>	<u>J.R.Smith</u>	<u>Zurn</u>
Exposed locations	58500-20	4405	Z1440
Underground	53010-30	4143	ZN1400
Walls, concealed	58790-20	4535	Z1446

PART 3 EXECUTION

3.1 GENERAL PLUMBING FIXTURE INSTALLATION INFORMATION

A. Verification of Conditions:

1. Examine rough-in work of water supply and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures.
2. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
3. Install plumbing fixtures level and plumb, in accordance with Fixture Manufacturer's written instructions, rough-in drawings and pertinent codes and regulations, design and referenced standards.
4. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
5. Install a stop valve in a readily accessible location in water connection to each fixture.
6. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Seal fixtures to walls and floors using silicone sealant Dow Corning No. 780 or equal. Match sealant color to fixture color.
8. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
9. Inspect each unit for damage prior to installation. Replace damaged fixtures.
10. Replace washers or cartridges of leaking or dripping faucets and stops.
11. Clean fixtures, trim and strainers using Manufacturer's recommended cleaning methods and materials.
12. During construction, cover installed fixtures, drains, sinks and water coolers with cardboard and wrap with sheet plastic.

13. Provide trap primers for floor drains, floor sinks, trench drains and hub drains.
 14. Install roof and overflow roof drains per architectural details. Cover drains during roof construction to protect drain. Provide offsets or expansion joints at each roof/overflow drain.
 15. Do not use lead flashing.
- B. Owner Furnished Equipment:
1. Rough-in and make final connections to Owner furnished equipment. Provide necessary items to complete installation.
 2. Comply with requirements of this Section and Drawings for installation procedures.
- C. Adjusting and Cleaning: Clean plumbing fixtures, trim, and strainers of dirt and debris upon completion of installation. Adjust water pressure at drinking fountains, faucets, shower valves and flush valves to provide proper flow stream and specified GPM. Repair leaks at faucets and stops.
- D. Extra Stock: Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner.
- E. Field Quality Control: Upon completion of installation of plumbing fixtures, test fixtures to demonstrate capability and compliance with Specifications. Correct or replace malfunctioning units at site, then retest to demonstrate compliance.
- F. Protection: Protect fixtures and equipment from damage. Cover finished fixtures with cardboard and sheet plastic. Fixtures are not to be used during construction. Replace damaged items with new.
- G. Signage: For fixtures that do not have ASSE 1070 mixing valve protection for hot water temperature, provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

3.2 EMERGENCY SHOWERS/EYEWASH INSTALLATION

- A. Install components in accordance with Manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

3.3 FLOOR DRAINS INSTALLATION

- A. Install components in accordance with Manufacturer's instructions and approved product data submittals.

- B. Set plumb, level and rigid.
- C. Set plumb, level and rigid. Set fixture rim/grate flush with surrounding finish surface unless specifically noted otherwise.

3.4 HOSE BIBB INSTALLATION

- A. Install components in accordance with Manufacturer's instructions and approved product data submittals.
- B. Set plumb, level and rigid.

END OF SECTION

DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING
(HVAC)

**SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING FOR HVAC**

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Air Moving and Conditioning Association, Inc. (AMCA): 203, Field Performance Measurement of Fan Systems.
 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE): HVAC Applications Handbook.
 3. Associated Air Balance Council (AABC): National Standards for Field Management and Instrumentation Total System Balance.
 4. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - b. Procedural Standards for Measuring Sound and Vibration.
 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): HVAC Testing, Adjusting, and Balancing Manual.

1.2 SUBMITTALS

- A. Informational Submittals:
1. Documentation of experience record of testing authority.
 2. Documentation of current AABC or NEBB certifications for those technicians in responsible charge of the work under this Contract. Submit detailed test and balance procedures, including test conditions for systems to be tested, prior to beginning the Work.
 3. Written verification of calibration of testing and balancing equipment.
 4. Balancing Log Report following completion of system adjustments including test results, adjustments, and rebalancing procedures.

1.3 QUALITY ASSURANCE

- A. Air Balancing and Vibration Test Agency Qualifications: Have a proven record of at least five similar projects.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Provide materials, tools, test equipment, computers and instrumentation required to complete the work included.
- B. Test Hole Plugs: Plug test holes in ducts with plugs made for that purpose and replace any insulation removed to specified conditions.

PART 3 EXECUTION

3.1 GENERAL

- A. Adjust and balance exhaust and supply air systems in accordance with standard procedures and recognized practices of the AABC or SMACNA.

3.2 AIR SYSTEM ADJUSTING AND BALANCING

- A. Preparation: Prior to beginning the Work, perform the following activities:
 1. Review Shop Drawings and installed system for adequate and accessible balancing devices and test points.
 2. Recommend to Engineer dampers that need to be added or replaced in order to obtain proper air control.
 3. Verify proper startup procedures have been completed on the system.
 4. Verify controls installation is complete and system is in stable operation under automatic control.
 5. Verify test instruments have been calibrated to a recognized standard and are within manufacturer's recommended calibration interval before beginning the Work.
- B. General:
 1. When adjustments are made to a portion of a fan system, reread other portions of that same system to determine effects imposed by adjustments. Readjust as necessary.

2. Lock and mark final positions of balancing dampers with permanent felt pen.
 3. Adjust or correct fan and airflow measurements as required for actual cubic feet per minute measured at Site elevation.
- C. Equipment Data: Collect the following data and include in final report:
1. Type of unit.
 2. Equipment identification number.
 3. Equipment nameplate data (including manufacturer, model, size, type, and serial number).
 4. Motor data (frame, hp, volts, FLA rpm, and service factor).
 5. Sheave manufacturer, size, and bore.
 6. Sheave centerline distance and adjustment limits.
 7. Starter and motor overload protection data.
 8. Include changes made during course of system balancing.
- D. Fan Systems:
1. Measure fan system performance in accordance with AMCA 203.
 2. In each system at least one airpath from fan to final branch duct termination shall have dampers fully open. Achieve final air quantities by adjusting fan speed.
 3. Adjust Fan Air Volumes:
 - a. Adjust fan speeds and motor drives for required equipment air volumes, with allowable variation of plus 10 percent minus 0 percent.
 - b. After final adjustments, do not operate motor above nameplate amperage on any phase.
 - c. After final adjustments, do not operate fan above maximum rated speed.
 - d. Perform airflow test readings under simulated or actual conditions.
 4. Adjust outside air dampers, supply air dampers, exhaust air dampers, and motorized louvers for maximum and minimum air requirements.

5. Read and record static pressures at unit inlet and discharge, each filter set, coils, dampers, plenums, and mixing dual-duct or adjustable- volume boxes, on every supply, return, and exhaust fan for each test condition.
 6. Read and record motor amperage on all phases for each test condition.
- E. Air Outlets and Inlets:
1. In each system at least one air path from fan to final branch duct termination shall have dampers fully open.
 2. Adjust air volumes on exhaust and supply diffusers and grilles, with allowable variation of plus or minus 10 percent.
 3. Adjust diffusers and grilles for proper deflection, throw, and coverage. Eliminate drafts and noise where possible.
 4. After final adjustments are made secure dampers to prevent movement and mark final positions with permanent felt pen.
- F. Building Static Pressure: Measure building static pressure relative to outside in perimeter entrances during normal system conditions that would yield widest range in internal building pressure. Adjust accordingly to maintain minimum of 0.05-inch WC negative pressure in the room with entrance doors closed to outside.

3.3 FIELD QUALITY CONTROL

- A. Vibration Performance Testing:
1. Upon completion of air system balance, perform vibration testing for all fans.
 2. Take measurements at each bearing housing using calibrated electronic analyzer.
 3. Measure velocity in direction parallel to rotating shaft, and in two directions perpendicular to shaft and to each other. Align measurement directions where possible to the horizontal and vertical planes.
 4. Record log shall include equipment symbol or tag, location, identification, specified vibration velocity limits, and maximum measured velocity in each direction.
 5. Notify Engineer if amplitude exceeds upper limit specified.

END OF SECTION

SECTION 23 09 13
INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes motorized control dampers and motorized control damper electric motor operators, except those furnished by fan manufacturer as packaged with fan equipment.

1.2 SUBMITTALS

- A. Action Submittals: Manufacturer's product data, catalog cut sheets, installation instructions, and operations and maintenance information for specified products.
- B. Submit shop drawings for the fabrication and erection of damper assemblies which are not completely shown by the manufacturer's data sheet. Include details of sections and connections. Show anchorage and accessory items.

PART 2 PRODUCTS

2.1 PRODUCTS

- A. General:
 - 1. Dampers shall be two-position, parallel-blade type for open-close service.

2.2 MOTORIZED CONTROL DAMPERS (MCD)

- A. Industrial Duty Motorized Dampers:
 - 1. Frame: 5 inches by 1 inch by minimum 0.125 inch (127 mm by 25 mm by minimum 3.2 mm) 6063-T5 extruded aluminum hat channel with hat mounting flanges on both sides of frame, reinforced at corners.
 - 2. Blades:
 - a. Style: Airfoil-shaped, single-piece.
 - b. Orientation: Horizontal or vertical with thrust washers, as indicated on Drawings.
 - c. Material: Heavy duty 6063-T5 extruded aluminum.
 - d. Width: Nominal 6 inches (152 mm).

3. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
4. Seals:
 - a. Blade Seals: Extruded neoprene type for ultra-low leakage from minus 22 to 122 degrees F (minus 30 to 50 degrees C). Mechanically attached to blade edge.
 - b. Jamb Seals: Flexible metal compression type.
5. Linkage: Concealed in frame.
6. Axles:
 - a. Minimum 1/2 inch (13 mm) diameter, hex-shaped, mechanically attached to blade.
 - b. Material: Galvanized steel.
 - c. Coordinate number of axles with the required number of actuators such that one axle is provided for each actuator. Multiple actuator on a single axle is not allowed.
7. Performance Data:
 - a. Temperature Rating: Withstand minus 22 to 122 degrees F (minus 30 to 50 degrees C).
 - b. Capacity: Demonstrate capacity of damper to withstand ventilation system operating conditions.
 - c. Closed Position: Maximum pressure of 13 inches w.g. (3.2 kPa) at 12-inch blade length (305).
 - d. Open Position: Maximum air velocity of 6,000 feet per minute (1,829 meter per minute).
 - e. Leakage: Maximum 5.2 cubic feet per minute per square foot (0.6 cubic meter per minute per square meter) at 4 inches w.g. (1 kPa) for size 48 inches by 48 inches (1219 by 1219 mm).
 - f. Pressure Drop: Maximum 0.03 inch w.g. (0.01 kPa) at 1,500 feet per minute (457 meters per minute) across 24-inch by 24-inch (610 by 610 mm) damper.
8. Accessories:
 - a. Actuator: Refer to Article Motorized Control Damper Electric Motor Operators, for requirements.

- b. Flange Frame: 1-1/2 inches (38 mm), roll formed as part of frame, double configuration.
 - c. Factory Sleeve: Minimum 20 gauge (1 mm) thickness, minimum 12 inch (305 mm) length.
 - d. Duct Transition Connection: Size and shape to mate with ductwork as shown on Contract Drawings.
9. Manufacturers and Products:
- a. Ruskin; Model CD-50.
 - b. American Warming and Ventilating.
 - c. TAMCO.

2.3 MOTORIZED CONTROL DAMPER ELECTRIC MOTOR OPERATORS

A. General:

1. Provide electric operators for motorized dampers.
2. Contract Drawings show only one motor per motorized damper. Select actual quantity of motors required to operate each damper in accordance with size of damper provided.
3. Coordinate exact quantity of damper motors with electrical work including sizing of electrical power supplies to ensure that necessary power, wiring and conduit is provided for complete installation.

B. Electric Damper Operators:

1. Performance:
 - a. 120VAC, two-position.
 - b. Spring return.
 - c. Fail Position: Damper Open.
2. Mounting: External side plate.
3. Ample power to overcome friction of damper linkage and air pressure acting on damper blades.
4. Furnished with external adjustable stops to limit stroke.

5. Operating Torque:

- a. Provide multiple independent damper sections, each with separate actuator, as needed to provide minimum of 120 percent of operating torque required by damper(s).
- b. Required damper operating torque for actuator sizing calculations shall include friction of damper linkage and 1-inch WC air pressure on damper blades. Operating torque shall be minimum of 7 inch-pounds per square foot of damper area for parallel blade dampers.

6. Manufacturers:

- a. Belimo.
- b. Siemens Building Technologies.
- c. Johnson Controls.
- d. Honeywell.

2.4 ELECTRIC THERMOSTATS

A. Room Thermostat for Process Spaces:

1. Two-position electric type for cooling applications.
2. Temperature Scale: 0 to 125 degrees F, dial type gauge.
3. External adjustments.
4. Adjustable sensitivity.
5. Insulating back where exterior wall mounting is indicated.
6. Locking wire protective guard.

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. The Contractor shall ascertain that all inserts, chassis, shafts and openings are correctly located.
2. The Contractor shall test and make tight all work, furnish all equipment necessary to carry out the tests and thoroughly clean the system before startup.

B. Motorized Control Dampers:

1. Install at motorized control damper locations indicated on Contract Drawings and in accordance with manufacturer's instructions.

2. Install square and free from racking with blades running horizontally.
3. Bracing:
 - a. Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
 - b. Install at every horizontal and vertical mullion.
- C. Motorized Control Damper Electric Motor Operators:
 1. Install quantity of electric operators required for each motorized damper, whether or not all motors are shown on Contract Drawings.
 2. Install operators in accordance with manufacturer's instructions.
 3. Coordinate installation of operators with all trades to avoid interference with architectural features, structural members, and electrical lighting.
 4. Electrical work shall include all wiring and conduit required for a complete installation of each motorized damper and shall be provided as part of the work of Division 26, Electrical.

END OF SECTION

SECTION 23 31 13
METAL DUCTS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

- A. The following is a list of standards which may be referenced in this section:
1. Air Movement and Control Association (AMCA): 500, Test Methods for Louvers, Dampers and Shutters.
 2. American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook.
 3. American Society of Mechanical Engineers (ASME): A13.1, Scheme for the Identification of Piping Systems.
 4. Association of the Nonwoven Fabrics Industry (INDA): IST 80.6, Water Resistance (Hydrostatic Pressure).
 5. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A90/A90M, Standard Test Method for Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - c. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - d. A176, Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip.
 - e. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - f. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
 - g. A568/A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 - h. A653/A653M, Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

- i. A700, Standard Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment.
 - j. A924/A924M, Specification for General Requirements for Sheet Steel, Metallic-Coated by the Hot-Dip Process.
 - k. A1008/A1008M, 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.
 - l. A1011/A1011M, 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.
 - m. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - n. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - o. C916, Standard Specification for Adhesives for Duct Thermal Insulation.
 - p. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - q. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
 - r. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - s. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
6. National Air Duct Cleaners Association (NADCA): General Specifications for the Cleaning of Commercial Heating, Ventilation and Air Conditioning Systems.
7. National Fire Protection Association (NFPA):
- a. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - b. 90B Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - c. 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - d. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.

- e. 259, Standard Test Method for Potential Heat of Building Materials.
 - f. 701, Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
- a. Duct Construction Standards.
 - b. Guidelines for Seismic Restraints of Mechanical Systems.
 - c. Fibrous Glass Duct Construction Standards.
 - d. Fire, Smoke, and Radiation Damper Installation Guide for HVAC Systems.
 - e. HVAC Air Duct Leakage Test Manual.
9. Underwriters Laboratories Inc.(UL):
- a. 181, Standard for Safety Factory-Made Air Ducts and Connectors.
 - b. 214, Standard for Tests for Flame-Propagation of Fabrics and Films.
 - c. 555, Standard for Safety Fire Dampers.
 - d. 555S, Standard for Safety Smoke Dampers.

1.2 DEFINITIONS

- A. The following is a list of abbreviations which may be used in this section:
- 1. CFM: cubic feet per minute.
 - 2. FPM: feet per minute.
 - 3. PCF: pounds per cubic foot.
 - 4. WC: water column.
- B. Sealing Requirements: For the purpose of duct systems sealing requirements specified in this section, the following definitions apply:
- 1. Seams: Joining of two longitudinally (in direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on perimeter are deemed to be joints.
 - 2. Joints, duct surface connections including:
 - a. Girth joints.
 - b. Branch and subbranch intersections.
 - c. Duct collar tap-ins.
 - d. Fitting subsections.
 - e. Louver and air terminal connections to ducts.
 - f. Access door, and access panel frames and jambs.
 - g. Duct, plenum, and casing abutments to building structures.

1.3 SUBMITTALS

A. Action Submittals:

1. Ductwork Product Data: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, hangers and supports, seam and construction details, and finishes.

Ductwork Accessories: Manufacturer's product data including catalog sheets, diagrams, standard schematic drawings, installation instructions and details, details of materials, construction, dimensions of individual components, and finishes.

- #### B. Informational Submittals: Seismic anchorage and bracing drawings, cut sheets, and calculations as required by Section 33 05 96 Vibration and Seismic Controls for Utilities.

PART 2 PRODUCTS

2.1 GENERAL

- #### A. Specified components of this ductwork system, including facings, mastics, and adhesives, shall have fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke developed, as per test conducted in accordance with ASTM E84 and NFPA 255 methods.
- #### B. Ductwork material shall be aluminum or galvanized steel, minimum thickness 24 gauge.
- #### C. Duct Sealants: Adhesives, cements, and sealants shall be as recommended by duct manufacturer for industrial applications.
- #### D. Ductwork Interior Surfaces:
1. Smooth.
 2. No sheet metal parts, tabs, angles, or other items may project into air ducts, unless otherwise specified.
 3. Seams and joints shall be external.

2.2 SHEET METAL MATERIALS

- #### A. Construct supply and exhaust duct systems from aluminum or galvanized steel construct odor control duct systems from stainless steel as specified herein.
- #### B. Galvanized Steel Ductwork:
1. Comply with ASTM A653/A653M and ASTM A924/924M.

2. Product Name: Steel Sheet, Zinc Coated (Galvanized Steel).
 3. Sheet Designation: CS Type B.
 4. Applicable Specification: ASTMA653/A653M.
 5. (Zinc) Coating Designation: G90.
 6. Coating designation in accordance with Test Method A, ASTM A90/A90M and ASTM A924/A924M.
 7. Provide mill-phosphatized finish for ducts exposed to view and for ducts scheduled to be painted.
 8. Provide sheet metal packaged and marked as specified in ASTM A700.
- C. Aluminum Ductwork:
1. Comply with ASTM B209.
 2. Aluminum Sheet: Alloy 3003-H14, unless indicated otherwise.
 3. Aluminum Connectors and Bar Stock: Alloy 6061-T6, or equivalent.
- D. Exposed Ductwork: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains, discoloration, and other imperfections, including those which would impair painting.
- E. Reinforcement Shapes and Plates: Unless otherwise indicated, provide reinforcements of same material as ductwork.

2.3 DUCT SEALING MATERIALS

- A. General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
- B. Adhesives, Cements, Sealant, and Installation Accessories: As recommended by duct manufacturer for application.
- C. Solvent-Based Sealants:
1. Ultraviolet light resistant.
 2. Mildew resistant.
 3. Flashpoint: Greater than 70 degrees F, SETACC.

4. Manufacturers and Products:
 - a. Hardcast, Inc.; Versagrip 102.
 - b. Rectorseal; AT-33.
 - c. Childers CP-140.
- D. Water-Based Sealants:
 1. Listed by manufacturer as nonflammable in wet and dry state.
 2. Manufacturers and Products:
 - a. Foster; Series 32.
 - b. Childers; CP-145A, 146.
 - c. Rectorseal; Airlok 181.
- E. Do not use silicone sealants at odor control ducting. Instead, utilize expanded Teflon (Gortex), or a Hypalon product.

2.4 DUCTWORK FASTENERS

- A. General:
 1. Rivets, bolts, or sheet metal screws.
 2. Ductwork fasteners shall be same metal as duct being supported, unless otherwise noted.
- B. Self-Drilling Screws:
 1. Galvanized Steel Ductwork System: Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated carbon steel with zinc electroplated finish.
 2. Aluminum Ductwork System:
 - a. Sheet metal screws shall be hex washer head (HWH) TEKS® self-drilling type, formed from heat-treated Type 410 stainless steel, complete with bonded metal and fiber washer for dielectric separation.
 - b. Manufacturers:
 - 1) DB Building Fasteners Inc., Santa Fe Springs, CA.
 - 2) Clark Craft Fasteners, Tonawanda, NY.

2.5 DUCTWORK PRESSURE CLASS

- A. Construct duct systems to pressure classifications indicated as follows:
 - 1. Supply Ducts: 3-inch WC.
 - 2. Return Ducts: 2-inch WC, negative pressure.
 - 3. Exhaust Ducts: 2-inch WC, negative pressure.
- B. Where no specific duct pressure designations are indicated in Specifications or on Drawings, 2-inch WC pressure class shall be basis of Contract.

2.6 RECTANGULAR DUCTWORK

- A. Fabricate rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible, unless specified otherwise.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20-gauge or less, with more than 10 square feet of unbraced panel area, as indicated in SMACNA Manual, unless they are lined or are externally insulated.

2.7 RECTANGULAR DUCTWORK FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- B. Elbows:
 - 1. Fit square-turn elbows with vane siderails.
 - 2. Shop fabricate double-blade turning vanes of same material as ductwork.
 - 3. Fabricate with equal inlet and outlet.
 - 4. Rectangular radius elbows with inside radius of 3/4 of duct width in direction of turn.
 - 5. Manufacturers and Products:
 - a. Elgen; All-Tight.
 - b. Duro-Dyne; Type TR.

2.8 RECTANGULAR DUCTWORK BRANCH CONNECTIONS

- A. Branch duct connections to rectangular duct mains shall be made using factory fabricated fittings with spot welded tap to main duct connections or with factory fabricated, field installed taps, with spin-in or mechanical fastened tap to main duct connections.

2.9 DUCTWORK FLEXIBLE CONNECTIONS

A. General:

1. Factory fabricated metal-edged fabric flexible connectors for commercial or industrial applications.
2. Sheet metal permanently secured to fabric with double fabric fold, double metal crimp.
3. Comply with NFPA 90A and NFPA 90B requirements.
4. Airtight and waterproof.

B. Materials:

1. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
2. Metal Edges: Construct from same material as ductwork, unless otherwise noted.
3. Fabric:
 - a. Comply with NFPA 701 or UL 214 (except Teflon coated).
 - b. Woven polyester or nylon.

C. Construction:

1. Fold and crimp metal edge strips onto fabric as illustrated in SMACNA Manual.
2. Standard Metal Edged Connectors: Strip of fabric 3 inches wide attached to two strips of 3-inch-wide sheet metal.
3. Wide Metal Edged Connectors: Strip of fabric 4 inches wide attached to two strips of 4-inch-wide sheet metal.
4. Extra Wide Metal Edged Connectors: Strip of fabric 6 inches wide attached to two strips of 6-inch-wide sheet metal.

D. Manufacturers:

1. Ductmate; PROflex, Commercial.
2. Ventfabrics.
3. Duro-Dyne.

2.10 DUCTWORK HANGERS AND SUPPORTS

A. General:

1. Attachments, hangers, and supports for ductwork shall be in accordance with SMACNA Manual referenced for type of duct system being installed.
2. Duct hanging system shall be composed of three elements; upper attachment to building, hanger itself, and lower attachment to duct.
3. Wire hangers are not acceptable.
4. Hanger Spacing:
 - a. Ducts Up to 60 inches in Largest Dimension: 10 feet, maximum.
 - b. Ducts Over 61 inches in Largest Dimension: 8 feet, maximum.

B. Construction Materials: Supporting devices including, but not limited to, angles used for support and bracing, baseplates, rods, hangers, straps, screws, bolts shall be as follows:

1. Of same material as ductwork.

C. Building Attachments:

1. Concrete inserts, powder-actuated fasteners, or structural steel fasteners appropriate for building materials.
2. Do not use powder-actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
3. Upper Attachment (Concrete):
 - a. Drive pin fastener and expansion nail anchor may be used for ducts up to 18-inch maximum dimension.
 - b. Threaded stud fastener may be used for ducts up to 36-inch maximum dimension.
 - c. Concrete attachments shall be made of steel.

D. Duct Fasteners: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials and conforming to requirements of Article Ductwork Fasteners.

E. Trapeze and Riser Supports: Steel shapes conforming to ASTM A36/A36M, hot-dipped galvanized after fabrication.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:

1. Install sheet metal ductwork and flexible ductwork in accordance with SMACNA Manual, NFPA 90A, and NFPA 90B.
2. Install ductwork using manufacturer's recommended adhesives, cement, sealant, and insulation accessories.
3. Joints and seams shall be sealed watertight.
4. Align ductwork accurately at connections, within 1/8-inch misalignment tolerance and with internal surfaces smooth.
5. Interface Between Ductwork and Louvers: At locations where ductwork is connected to louver for either intake or exhaust purposes, ductwork shall be installed, sloped, and connected to louver so water entering ductwork system positively drains back to and out of louver.

B. Ductwork Location:

1. Locate ductwork runs vertically and horizontally, unless otherwise indicated.
2. Avoid diagonal runs wherever possible.
3. As indicated by diagrams, details, and notations or, if not otherwise indicated, run ductwork in shortest route that does not obstruct usable space or block access for servicing building and equipment.
4. In general, install as close to bottom of structure as possible.
5. For ductwork concealed above ceiling, maximize clearance between bottom of ductwork and top of ceiling construction.
6. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
7. Ductwork that must transition and drop below piping or other ductwork shall be transitioned back to bottom of structure immediately adjacent to obstruction.

C. Penetrations:

1. Clearances:

- a. For uninsulated ducts, allow 1-inch clearance between duct and sleeve, except at grilles, registers, and diffusers.
- b. For insulated ducts, allow 1-inch clearance between insulation and sleeve, except at grilles, registers, and diffusers.

2. Closure Collars:

- a. Minimum 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed.
- b. Fit collars snugly around ducts and insulation.
- c. Same gauge and material as duct.
- d. Grind edges of collar smooth to preclude tearing or puncturing insulation covering or vapor barrier.
- e. Use fasteners with maximum 6-inch centers on collars.

3. Packing: Mineral fiber in spaces between sleeve or opening and duct or duct insulation.

D. Coordination with Other Trades:

1. Coordinate duct installation with installation of louvers, dampers, and ductwork accessories.
2. Ductwork shall be configured, positioned, and installed to permit installation of light fixtures as indicated on Drawings.
3. Coordinate ductwork layout to avoid interference with lighting, bridge crane, suspended ceiling, tanks, generator, electrical panels and all process equipment.

3.2 RECTANGULAR DUCTWORK

A. General:

1. Where possible, install ductwork so seams and joints will not be cut for installation of grilles, registers, or ceiling outlets.
2. If cutting of seams or joints is unavoidable, reinforce cut portion to original strength.

B. Low Pressure Taps:

1. Use bell mouth or conical fittings with integral locking quadrant damper. Spin-in fitting shall be sealed at duct tap with a gasket or sealed with sealant as specified for medium pressure ductwork.
 2. Determine location of spin-in after outlet location is determined.
 3. Fitting shall be securely attached to shaft to prevent damper from rotating around shaft.
- C. Fittings:
1. Use 45-degree entry fittings conforming to SMACNA requirements for rectangular takeoffs from rectangular mains.
 2. Make offsets with maximum angle of 45 degrees.
 3. Use fabricated fittings for changes in directions, changes in size and shape, and connections.
- D. Rectangular Ductwork Transverse Joints:
1. Install each run with a minimum of joints.
 2. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
 3. Mechanical Joint Option:
 - a. Construct transverse joints with Ductmate 25/35 duct connector systems, Ductmate W.D.C.I. Heavy/Lite duct connector systems, or Ductlok J/E duct connector system. Slip-on duct flange connectors shall have integral sealant pocket with permanently flexible sealant.
 - b. When using Ductmate W.D.C.I. Heavy/Lite system, construct ductwork in accordance to the Ductmate W.D.C.I. Heavy J and Light H Assembly Manual and Duct Construction Standards.
 - c. When using Ductlok J/E duct connector system, construct ductwork in accordance with Ductlok's Rectangular Duct Construction Manual for Low, Medium, and High Pressure.
 - d. For longitudinal seams, use Pittsburgh lock seam sealed internally with permanently elastic sealer such as Ductmate 5511M mastic.
 - e. Conform to SMACNA Class A sealing requirements.

3.3 FLEXIBLE CONNECTIONS

A. Flexible Collars and Connections:

1. Use between fans and ducts.
2. For rectangular ducts, lock flexible connections to metal collars.

3.4 DUCTWORK HANGERS AND SUPPORTS

- A. Install ductwork with support systems in accordance with SMACNA Manual, unless otherwise noted.
- B. Support ducts rigidly with suitable ties, braces, hangers, and anchors of type, which will hold ducts true-to-shape and to prevent buckling.
- C. Install additional bracing on ductwork as required, to prevent ballooning or breathing.
- D. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- E. Upper attachments to structures shall have allowable load not exceeding 1/4 of failure (proof test) load, but are not limited to specific methods indicated.
- F. In new construction, install concrete insert prior to placing concrete.

3.5 DUCT SEALING

A. Seal duct seams and joints as follows:

1. In accordance with SMACNA requirements.
- B. If no specific duct sealing requirements are specified, requirements of SMACNA manual shall govern.
 - C. Provide additional duct sealing as required to comply with Article Ductwork Leakage Testing.
 - D. Seal all audible leaks.

3.6 DUCTWORK LEAKAGE TESTING

A. General:

1. Tests shall be conducted on completed ductwork systems.
2. Testing of partial installations or limited sections of ductwork will not be acceptable.

3. All ductwork leakage test procedures and results shall be submitted to Engineer for review.
 4. Engineer shall retain the right to witness some or all ductwork leakage testing procedures.
 5. Subcontractor shall notify Engineer in writing at least 5 working days prior to ductwork testing.
- B. Leakage Criteria:
1. Assemble and install ductwork with maximum leakage limited as follows:
 - a. Minimum test pressure: 1-inch WC
 - b. Allowable leakage: 2 percent of design airflow
- C. Leakage Testing Method:
1. Subcontractor shall be responsible for providing all necessary test fans and calibrated measuring devices to accomplish ductwork leakage test and to demonstrate that ductwork systems leakage rate is less than maximum rate specified.
 2. Pressure testing shall be accomplished using a pressure blower with a calibrated orifice and manometer.
 3. Blower shall maintain SMACNA construction pressure classification during test.
 4. Perform testing in accordance with procedures given in SMACNA HVAC Air Duct Leakage Test Manual.

3.7 BALANCING OF AIR SYSTEMS

- A. Perform air balancing in accordance with requirements of Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

3.8 CLEANING

- A. Ductwork shall be cleaned of rust, dust, and debris, both internally and externally, before placing in operation.
- B. Before installing air outlets, use air handler to blow dry air through entire system at maximum attainable velocity. Provide temporary air filters for this operation.
- C. If duct systems are found to contain construction debris at time of construction completion Subcontractor shall provide complete ductwork system cleaning in accordance with NADCA Standards.

END OF SECTION

SECTION 23 34 00
HVAC FANS

PART 1 GENERAL

1.1 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Acoustical Society of America (ASA)
2. Air Movement and Control Association International (AMCA)
3. American Bearing Manufacturers Association (ABMA)
4. ASTM International (ASTM)
5. National Electrical Manufacturers Association (NEMA)
6. Occupational Safety and Health Act (OSHA)
7. Underwriters Laboratories Inc. (UL)

1.2 SUBMITTALS

A. Action Submittals: Provide for all products specified, as follows:

1. Unit tag number or equipment identification as referenced in Contract Documents.
2. Manufacturer's name and model number.
3. Descriptive specifications, literature, and drawings.
4. Dimensions and weights.
5. Fan sound power level data (reference 10 to power minus 12 Watts) at design operating point.
6. Fan Curves:
 - a. Performance Curves Indicating:
 - 1) Relationship of flow rate to static pressure for various fan speeds.
 - 2) Brake horsepower curves.

- 3) Acceptable selection range (surge curves, maximum revolutions per minute, etc.).
 - 4) Static pressure, capacity, horsepower demand, and overall efficiency required at the duty point, including drive losses.
7. Capacities and ratings.
 8. Construction materials.
 9. Fan type, size, class, drive arrangement, discharge, rotation, and bearings.
 10. Wheel type, diameter, revolutions per minute, and tip speed.
 11. Motor and Power Data.
 12. Manufacturer's standard vibration isolation accessories.
 13. Factory finish system.
- B. Informational Submittals:
1. Recommended procedures for protection and handling of products prior to installation.
 2. Manufacturer's installation instructions, including seismic anchorage and bracing requirements.
 3. Factory test reports.
 4. Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 FAN DRIVES

- A. Drive assembly shall be sized for a minimum 140 percent of fan motor horsepower rating.
- B. Shaft Guard:
 1. Provide shaft guard for each fan and drive not housed in its own fan enclosure.
 2. Shaft guards shall be easily removable and enclose entire drive assembly, meeting federal and OSHA requirements.

3. Guard faces shall be constructed of expanded metal having minimum 60 percent free area for ventilation.

2.2 FINISHES

- A. Carbon Steel Parts: Factory finish as follows, unless indicated otherwise.
 1. Parts cleaned and chemically pretreated with a phosphatizing process.
 2. Alkyd enamel primer.
 3. Air-dry enamel topcoat.
- B. Aluminum Parts: Finished smooth and left unpainted, unless stated otherwise.
- C. Stainless Steel Parts: Finished smooth and left unpainted.

2.3 CENTRIFUGAL INLINE FANS

- A. General Description:
 1. Fan arrangement shall be exhaust, see Fan Schedule
 2. Belt driven, Inline duct mounted applications
 3. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number
- B. Wheel:
 1. Wheel shall be backward inclined and aluminum
 2. Statically and dynamically balanced in accordance with AMCA Standard 204-05
 3. The wheel cone and inlet cone will be matched and shall have precise running tolerances for maximum performance and operating efficiency
- C. Fan Shafts:
 1. Precision ground and polished, mounted in permanently sealed, lubricated pillow block bearings.
 2. Bearings shall have a minimum L10 life in excess of 100,000 hours at maximum operating speed.
- D. Motors:
 1. Motor enclosures: Totally enclosed fan cooled

2. Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at 120 voltage and single phase
 3. Accessible for maintenance
- E. Drive Frame:
1. Drive frame assemblies and fan panels shall be galvanized steel
 2. Drive frame shall have welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges and a deep formed one-piece inlet venturi
- F. Disconnect Switches:
1. NEMA rated: 4X
 2. Positive electrical shut-off
 3. Wired from fan motor to junction box
- G. Manufacturers and Products:
1. See drawing schedules for basis of design manufacturers and models.

2.4 MOTORS

- A. General:
1. Provide integral self-resetting overload protection on single-phase motors.
 2. Motors shall not operate into service factor in any case.
- B. Motor requirements shall be as follows, unless designated otherwise on Equipment Schedule:
1. Electrically commutated, permanent magnet type
 2. Torque Characteristics: Sufficient to accelerate driven loads satisfactorily
 3. Solid state electronics
 4. Shaft Type: Solid, carbon steel
 5. Mounting: As required for fan arrangement

2.5 ACCESSORIES

- A. Equipment Identification Plates: Furnish 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch high engraved or die-stamped block type equipment identification number and letters indicated in this Specification and as shown on Drawings. All units shall include factory installed permanently attached nameplate displaying unit model and serial number.
- B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fans level and plumb.
- B. Labeling: Label fans in accordance with Article Accessories.
- C. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.
- D. Connections:
 - 1. Refer to Section 23 31 13, Metal Ducts and Accessories.
 - 2. Isolate duct connections to fans.
 - 3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify blocking and bracing used during shipping are removed.
 - 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.

5. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
 6. Verify lubrication for bearings and other moving parts.
 7. Verify manual and automatic volume control and dampers in connected ductwork are in fully open position.
- B. Performance Tests:
1. Starting Procedures:
 - a. Energize motor and adjust fan to indicated revolutions per minute.
 - b. Measure and record motor voltage and amperage.
 2. Operational Test:
 - a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
 - c. Test and adjust control safeties.
 - d. Replace damaged and malfunctioning controls and equipment.

3.3 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to Manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

3.4 SUPPLEMENT

- A. See drawings for the Fan Schedule

END OF SECTION

**SECTION 23 37 00
AIR OUTLETS AND INLETS**

PART 1 GENERAL

1.1 SUBMITTALS

- A. Action Submittals: Manufacturer's data and descriptive literature for specified products.

PART 2 PRODUCTS

2.1 SUPPLY GRILLES

- A. Supply Grilles (SG):
 1. Construction: Aluminum, baked white enamel.
 2. Adjustable front horizontal and rear vertical vanes on 3/4-inch centers.
 3. Continuous sponge rubber gasket at face flange.
 4. One-inch minimum flat rectangular frame.
 5. Manufacturers and Products:
 - a. See drawings for basis of design HVAC diffusers/grills manufacturers and model numbers.

2.2 EXHAUST GRILLES

- A. Louvered Return, Exhaust and Transfer Grilles and Registers (EG):
 1. Construction: Aluminum, baked white enamel.
 2. Fixed horizontal louvers set at 35 degrees to 45 degrees.
 3. One-inch minimum flat, rectangular frame.
 4. Manufacturers and Products:
 - a. See drawings for basis of design HVAC diffusers/grills manufacturers and model numbers.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Contract Drawings for coordination of locations with structural members, ceiling grids, and lighting.
- B. Install grilles on their respective mounting surfaces, level, plumb, and true with room dimensions.
- C. Provide appropriate frame to adapt to mounting surface. Provide a 24-inch by 24-inch lay-in ceiling module for grilles in lay-in ceilings.
- D. Support air inlets and outlets per applicable building code where inlets and outlets may be installed in metal suspension systems.

END OF SECTION

SECTION 23 81 40
HEAT PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

Units shall be factory assembled, split system (ducted and ductless), Elec/Elec, HPU (compressor) designed for outdoor installation. The units shall be factory wired, piped, and charged with R-410A refrigerant and factory tested prior to shipment. All unit wiring shall be both numbered and color coded. The cooling performance shall be rated in accordance with DOE and AHRI test procedures. Units shall be CSA certified to ANSI Z21.47 and UL 60335-2-40 standards.

1.2 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Acoustical Society of America (ASA)
2. Air Movement and Control Association International (AMCA)
3. American Bearing Manufacturers Association (ABMA)
4. ASTM International (ASTM)
5. National Electrical Manufacturers Association (NEMA)
6. Occupational Safety and Health Act (OSHA)
7. Underwriters Laboratories Inc. (UL)

1.3 SUBMITTALS

A. Action Submittals: Provide for all products specified, as follows:

1. Unit tag number or equipment identification as referenced in Contract Documents.
2. Manufacturer's name and model number.
3. Descriptive specifications, literature, and drawings.
4. Dimensions and weights.
5. Capacities and ratings.
6. Construction materials.

7. Motor and Power Data.
 8. Manufacturer's standard vibration isolation accessories.
 9. Factory finish system.
- B. Informational Submittals:
1. Recommended procedures for protection and handling of products prior to installation.
 2. Manufacturer's installation instructions, including seismic anchorage and bracing requirements.
 3. Factory test reports.
 4. Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENT

- A. See drawings HVAC schedules for performance requirements.

2.2 UNIT CABINET

Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 1,000-hour salt spray test per ASTM-B117 standards. Indoor blower sections shall be insulated with up to 1-inch-thick insulation coated on the airside. Either aluminum foil faced or elastometric rubber insulation shall be used in the unit's compartments and be fastened to prevent insulation from entering the air stream. Cabinet doors shall be hinged with toolless access for easy servicing and maintenance. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating bypass of the coils. Condensate pan shall be slide out design or easy access, constructed of a non-corrosive material, internally sloped and conforming to ASHRAE 62-B9 standards. Condensate connection shall be a minimum of 3/4-inch inside diameter (I.D.) female and be rigid mount connection.

2.3 OUTDOOR COMPRESSOR FAN ASSEMBLY

The outdoor fans shall be of the direct drive type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets and shall be dynamically balanced for smooth operation. The outdoor fan motors shall have permanently lubricated bearings

internally protected against overload conditions and staged independently. A cleaning window shall be provided on two sides of the units for coil cleaning.

2.4 REFRIGERANT COMPONENTS

A. Compressors:

1. Shall be fully hermetic type, direct drive, internally protected with internal high-pressure relief and over temperature protection. The hermetic motor shall be suction gas cooled and have a voltage range of plus or minus 10 percent of the unit nameplate voltage.
2. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.

B. Coils:

1. Evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed. Special Phenolic coating shall be available as a factory option.
2. Evaporator coils shall be of the direct expansion, draw-thru design.
3. Condenser coils shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed or Micro-Channel aluminum tube, aluminum fins. Special Phenolic coating shall be available as a factory option.
4. Condenser coils shall be of the draw-thru design.

C. Refrigerant Circuit and Refrigerant Safety Components shall include:

1. Independent fixed-orifice or thermally operated expansion devices.
2. Solid core filter drier/strainer to eliminate any moisture or foreign matter.
3. Accessible service gauge connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge.
4. The unit shall have two independent refrigerant circuits, equally split in 50 percent capacity increments.

D. Refrigerant Lines:

1. All exposed refrigerant lines shall be insulated. Exterior exposed refrigerant lines shall be enclosed in expandable lineset covers.

- a. Lineset covers shall be Rectorseal, Cover Guard or equal.
 2. Insulation shall be a flexible, closed-cell elastomeric pipe insulation and shall conform to ASTM C534 Grade 1, Type I.
 3. Insulation materials shall have a closed cell structure to prevent moisture from wicking which makes it an efficient insulation. Insulation materials shall be manufactured without the use of CFC's, HFC's or HCFC's. It is also formaldehyde free, low VOCs, fiber free, dust free and resists mold and mildew.
 4. Insulation materials shall have a flame-spread index of less than 25 and a smoke-developed index of less than 50 as tested in accordance with ASTM E 84. In addition, the products, when tested, shall not melt or drip flaming particles, and the flame shall not be progressive.
 5. Insulation materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft² -°F at a 75°F mean temperature as tested in accordance with ASTM C 177 or ASTM C 518.
 6. Insulation materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A.
- E. Unit Controls:
1. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
 2. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit should any of the following standard safety devices trip and shut off compressor:
 - a. Loss-of-charge/Low-pressure switch
 - b. High-pressure switch
 3. Freeze condition sensor on evaporator coil. If any of these safety devices trip, the LCD screen will display the alarm message.
 4. Unit shall incorporate "AUTO RESET" compressor over temperature, over current protection.
 5. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.
 6. Unit control board shall have on-board diagnostics and fault message display.

7. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to a selectable value as low as 0 degrees Fahrenheit (F).

8. Control board shall monitor each refrigerant safety switch independently.

2.5 ELECTRIC HEATING SECTION

Not used.

2.6 UNIT OPERATING CHARACTERISTICS

Unit shall be capable of starting and running at 125 degrees F outdoor temperature, exceeding maximum load criteria of AHRI Standard 340/360. The compressor, with standard controls, shall be capable of operation down to 0 degrees F outdoor temperature.

2.7 ELECTRICAL REQUIREMENTS

All unit power wiring shall enter unit cabinet at a single factory provided location and be capable of side or bottom entry to minimize penetrations and avoid unit field modifications. Separate side and bottom openings shall be provided for the control wiring.

2.8 WARRANTIES

Compressor – 10 Years, limited parts.

Air Handler – 10 Years, limited parts.

2.9 ACCESSORIES

A. Equipment Identification Plates: Furnish 16-gauge Type 316 stainless steel identification plate securely mounted on each separate equipment component in a readily visible location. Plate shall bear 3/8-inch high engraved or die-stamped block type equipment identification number and letters indicated in this Specification and as shown on Drawings. All units shall include factory installed permanently attached nameplate displaying unit model and serial number.

B. Lifting Lugs: Furnish suitably attached for equipment assemblies and components weighing over 100 pounds.

2.10 MANUFACTURERS AND PRODUCTS:

See Drawings for HVAC heat pump schedule and basis of design manufacture and model.

A. Goodman

B. Fujitsu

- C. Or Approved Equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install heat pump compressors and air handlers per manufacturers requirements, level and plumb.
- B. Wall Mounted Ductless Units: Attach to structure using manufacturers provided wall bracket and per manufacturers requirements.
- C. Labeling: Label fans in accordance with Article Accessories.
- D. Service Access: Locate units to provide access spaces required for motor, drive, bearing servicing, and fan shaft removal.
- E. Connections:
 - 1. Refer to Section 23 31 13, Metal Ducts and Accessories.
 - 2. Isolate duct connections to fans.
 - 3. Install ductwork adjacent to fans to allow proper service and maintenance.

3.2 FIELD QUALITY CONTROL

- A. Functional Tests:
 - 1. Verify blocking and bracing used during shipping are removed.
 - 2. Verify fan is secure on mountings and supporting devices, and connections to ducts and electrical components are complete.
 - 3. Verify proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 4. Verify that cleaning and adjusting are complete.
 - 5. Verify proper motor rotation direction and verify fan wheel free rotation and smooth bearing operation.
 - 6. Verify lubrication for bearings and other moving parts.
 - 7. Verify manual and automatic volume control and dampers in connected ductwork are in fully open position.

B. Performance Tests:

1. Starting Procedures:

- a. Energize motor and adjust fan to indicated revolutions per minute.
- b. Measure and record motor voltage and amperage.

2. Operational Test:

- a. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
- b. Repair or replace malfunctioning units; retest as specified after repairs or replacement is made.
- c. Test and adjust control safeties.
- d. Replace damaged and malfunctioning controls and equipment.

3.3 CLEANING

- A. After completing system installation, including outlet fitting and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.
- B. On completion of installation, internally clean fans according to Manufacturer's written instructions. Remove foreign material and construction debris. Vacuum fan wheel and cabinet.

3.4 SUPPLEMENT

Not used.

END OF SECTION

DIVISION 26 - ELECTRICAL

SECTION 26 05 00

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies general requirements applicable to all electrical work to be completed at the facility. This may include such things as underground conduit, surface conduit, motors, control components and similar.
- B. Section includes:
 - 1. Scope.
 - 2. Definitions.
 - 3. Reference Standards.
 - 4. Quality Assurance.
 - 5. Submittals.
 - 6. Drawings.
 - 7. Project Site Conditions.
 - 8. Equipment Coordination.
 - 9. Basis of Design.
 - 10. Products.
 - 11. Execution – General.
 - 12. Testing.

1.2 SCOPE

- A. This section specifies general requirements for electrical work. Detailed requirements for specific electrical items are specified in other sections but are subject to the general requirements of this section.
- B. Related Sections:
 - 1. The Contract Documents are complementary; what is called for by one is as binding as if called for by all.
 - 2. It is the Contractor's responsibility for scheduling and coordinating the Work of subcontractors, suppliers, and other individuals or entities performing or furnishing any of Contractor's Work.
- C. Interfaces to Equipment, Instruments, and Other Components:

1. The Drawings, Specifications, and overall design are based on preliminary information furnished by various equipment manufacturers, which identify a minimum scope of supply from the manufacturers. This information pertains to, but is not limited to, instruments, control devices, electrical equipment, packaged mechanical systems, and control equipment provided with mechanical systems.
 2. Provide all material and labor needed to install the actual equipment furnished. Include additional conduit, wiring, terminals, or other electrical hardware to the work, which may be necessary to make a complete functional installation, based on the actual equipment furnished:
 - a. Make all changes necessary to meet the manufacturer's wiring requirements.
 3. Submit all such changes and additions to the Engineer for acceptance in accordance with the General Conditions.
 4. Review the complete set of Drawings and Specifications in order to ensure that all items related to the electrical power and control systems are completely accounted for. Include items that appear on Drawings or in Specifications from another discipline in the scope of Work:
 - a. If a conflict between Drawings and Specifications is discovered, refer conflict to the Engineer as soon as possible for resolution.
- D. All electrical equipment and systems for the entire project shall comply with the requirements of Division 26, whether referenced in the individual equipment specifications or not:
1. The requirements of Division 26 apply to all electrical work specified in other Divisions and Sections, including HVAC controls, packaged mechanical systems, Local Control Panels (LCPs), Vendor Control Panels (VCPs), Instruments Junction Boxes (IJBs), Power Junction Boxes (PJBs) and enclosures.
 2. The Owner is not responsible for any additional costs due to the failure of the Contractor to notify all Subcontractors and suppliers of the Division 26 requirements.
- E. Contract Documents:
1. General:
 - a. The Drawings and Specifications are complementary and are to be used together to fully describe the Work.
 2. Contract Drawings:

- a. The electrical Drawings show in a diagrammatic manner, the desired locations, and arrangements of the components of the electrical work. Follow the Drawings as closely as possible. Use professional judgment and coordinate with the other trades to secure the best possible installation. Use the entire Drawing set for construction purposes.
- b. Locations of equipment, control devices, instruments, boxes, and panels are approximate only, exercise professional judgment in executing the Work to ensure the best possible installation:
 - 1) The equipment locations and dimensions shown on plans and elevations are approximate. Use the Shop Drawings to determine the proper layout, foundation, and pad requirements for final installation. Coordinate with all Subcontractors to ensure that all electrical equipment is compatible with other equipment and space requirements. Make changes required to accommodate differences in equipment dimensions.
 - 2) The Contractor has the freedom to select any of the named manufacturers, as identified in the individual specification sections. The Engineer has designed the spatial equipment layout based upon a single manufacturer and has not confirmed that every named manufacturer's equipment fits in the allotted space. It is the Contractor's responsibility to ensure that the equipment being furnished fits within the defined space.
- c. Installation Details:
 - 1) The Contract Drawings include typical installation details, which show the means and methods the Contractor is to use to install electrical equipment. For cases where a typical detail does not apply, develop installation details that may be necessary for completing the Work, and submit these details for review by the Engineer.

F. Utility Coordination:

- 1. The Contractor shall coordinate with the local electric Utility for the installation of the electrical service at the Owner's facility as specified in section 26 05 85.

1.3 DEFINITIONS

- A. **WIRING, ELEMENTARY OR SCHEMATIC DIAGRAM:** A schematic (elementary) diagram shows, by means of graphic symbols, the electrical connections and functions of a specific circuit arrangement. The schematic diagram facilitates tracing the circuit and its functions without regard to the actual physical size, shape, or location of the component devices or parts.

- B. ONE-LINE DIAGRAM: A one-line diagram shows by means of single lines and graphical symbols the course of an electrical circuit or system of circuits and the components, devices or parts used therein. Physical relationships are usually disregarded.
- C. BLOCK DIAGRAM: A block diagram is a diagram of a system, instrument, computer, or program in which selected portions are represented by annotated boxes and interconnecting lines.
- D. CONNECTION DIAGRAM: A connection diagram includes all of the devices in a system and shows their physical relationship to each other including terminals and interconnecting wiring in an assembly. This diagram shall be (a) in a form showing interconnecting wiring only by terminal designation (wireless diagram), or (b) a panel layout diagram showing the physical location of devices plus the elementary diagram.
- E. INTERCONNECTION DIAGRAM:
 - 1. Interconnection diagrams shall show all external connections between terminals of equipment and outside points, such as motors and auxiliary devices. References shall be shown to all connection diagrams which interface to the interconnection diagrams. Interconnection diagrams shall be of the continuous line type. Bundled wires shall be shown as a single line with the direction of entry/exit of the individual wires clearly shown. Wireless diagrams and wire lists are not acceptable.
 - 2. Each wire identification as actually installed shall be shown. The wire identification for each end of the same wire shall be identical. All devices and equipment shall be identified. Terminal blocks shall be shown as actually installed and identified in the equipment complete with individual terminal identification.
 - 3. All jumpers, shielding and grounding termination details not shown on the equipment connection diagrams shall be shown on the interconnection diagrams. Wires or jumpers shown on the equipment connection diagrams shall not be shown again on the interconnection diagram. Signal and DC circuit polarities and wire pairs shall be shown. Spare wires and cables shall be shown.
- F. ARRANGEMENT, LAYOUT, and/or OUTLINE DRAWINGS: An arrangement, layout, and or outline drawing is one which shows the physical space and mounting requirements of a piece of equipment. It may also indicate ventilation requirements and space provided for connections or the location to which connections are to be made.

1.4 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NECA-1	National Electrical Contractors Association – Standard Practices for Good Workmanship in Electrical Contracting
NFPA-70 NFPA-70E	National Electrical Code (NEC) Electrical Safety in the Workplace
NEMA	National Electrical Manufacturers Association
IEEE	Institute of Electrical and Electronic Engineers
IES	Illuminating Engineering Society
IBC	International Building Code
WAC	Washington Administration Code

1.5 QUALITY ASSURANCE

A. IDENTIFICATION OF LISTED PRODUCTS:

1. Electrical equipment and materials shall be listed for the purpose for which they are to be used, by an independent testing laboratory. Three such organizations are Underwriters Laboratories (UL), Factory Mutual (FM), and Electrical Testing Laboratories (ETL). Independent testing laboratory shall be acceptable to the inspection authority having jurisdiction.
2. When a product is not available with a testing laboratory listing for the purpose for which it is to serve, the product may be required by the inspection authority, to undergo inspection at the manufacturer's place of assembly. All costs and expenses incurred for such inspections shall be included in the original contract price. Contractor shall comply with Washington Administrative Code regulations concerning Listing requirements for electrical equipment.

- B. FACTORY TESTS: Where specified in the individual product specification section, factory tests shall be performed at the place of fabrication and performed on completion of manufacture or assembly. The costs of factory tests shall be included in the contract price.
- C. DELIVERY AND STORAGE:
 - 1. Delivery and storage per Section 01 66 00.

1.6 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.

- b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
4. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.
 5. Interconnection diagram: The Contractor shall prepare interconnection diagrams depicting all cable requirements together with their actual terminations as specified.
 6. Conduit layout drawings indicating size, location, and support, for all conduits other than single runs of 1-inch diameter or less cast in concrete construction.
 - a. Conduit layout drawings shall illustrate a system which conforms to the requirements of the project.
 - b. For changes to the layouts shown on the contract documents, provide engineering design and calculations signed and sealed by a Professional Engineer registered in State of Washington. Engineering design and calculations shall demonstrate that the proposed layout does not impair or significantly reduce the design structural strength.
 7. Safety disconnect switch list including legend with equipment tag, equipment description, and power feeder circuit source and location information.
 8. Roof Penetrations: Submit details of all portions of the electrical installation that penetrate the roof. Include details showing support of the penetrating component, and the sealing means to be utilized.
 9. Maintenance Data: For all equipment and for components to include in maintenance manuals specified in Division 1 General Requirements. In addition to requirements specified in Section 01 77 00 - Project Closeout and 01 78 23 - Operations and Maintenance Data include the following:
 - a. Routine maintenance requirements for equipment and components.

10. Manufacturer's written instructions for testing and adjusting.

1.7 WARRANTY

- A. Provide a written warranty covering the work done under this Division as required by the General Conditions. Incandescent lamps will be excluded from this warranty.
- B. Apparatus:
 - 1. Free of defects of material and workmanship and in accord with the Contract Documents.
 - 2. Built and installed to deliver its full rated capacity at the efficiency for which it was designed.
 - 3. Operate at full capacity without objectionable noise or vibration.
- C. Systems: Any system damage caused by failures of any system component shall be included.

1.8 DRAWINGS

- A. Where the Contractor is required to provide information on drawings as part of the specified work, such drawings shall be prepared on 11-inch by 17-inch paper, and on CD Rom in AutoCAD 2020. Drawings shall be complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing. Drawing quality and size of presentation shall be such as to permit 50 percent reduction of such drawings for insertion in operation and maintenance manuals. Drawings deemed illegible shall be rejected.
- B. Where the Contractor is required to provide equipment or system submittal information on drawings as part of the specified work, such drawings shall be prepared on 11-inch by 17-inch paper and shall be included within a three-ring binder. Drawings shall be complete with borders and title blocks clearly identifying project name, equipment and the scope of the drawing. Drawing quality and size of presentation shall be such as to permit 50 percent reduction of such drawings for insertion in operation and maintenance manuals. Drawings deemed illegible shall be rejected.

1.9 PROJECT/SITE CONDITIONS

- A. GENERAL: Unless otherwise specified, equipment and materials shall be sized and derated for the ambient condition of 40 degrees C at an elevation ranging from sea level to 3000 feet without exceeding the manufacturer's stated tolerances.
- B. OPERATING FACILITY: When working in an operating facility, such as a pump station or treatment plant, portions of this facility must remain fully functional throughout the

entire construction period. In consideration of this requirement, comply with the following guidelines:

1. All outages must be of minimal duration and fully coordinated and agreed to by the Owner. Adjust the construction schedule to meet the requirements of the Owner. All changes in schedule and any needs to reschedule are included in the Work.
 2. As weather and operational conditions dictate, re-adjust the construction schedule to meet the demands placed upon Owner by its users.
 3. Coordinate the construction and power renovation, bear all costs, so that all existing facilities can continue operation throughout construction.
- C. HAZARDOUS (CLASSIFIED) AREAS: All areas are designated as 'Unclassified' in accordance with the NEC, NFPA 820.
- D. SEISMIC: Electrical equipment supports, and anchorage shall be designed and installed in accordance to Section 01 41 20.

1.10 ELECTRICAL NUMBERING SYSTEMS

- A. TAGGING: All circuit raceways and armored cables shall be tagged at all terminations, panels, MCCs, pull boxes, junction boxes, etc. in accordance with the assigned numbers on the circuit/raceway schedule and schematic/plan drawings. The tags shall be installed in a clean and high workmanship manner. In addition to tags at the terminations, exposed raceways and armored cables shall be tagged at each side of concealment.
1. The standards of documentation, instrument tagging, cable and conductor ferruling, terminal identification and labeling that apply to the new installation apply equally to the existing installation which forms part of the modified system.
- B. PREFIX MODIFIERS: The following prefix modifiers shall be used when scheduling/tagging cables and raceway:

Raceway Prefix	Type of Function
H	Power above 600V
P	Power 120V to 600V
C	Control or power - 120V or less
S	Low level signal (less than 90-volt communication or less than 30-volt instrumentation)
D	Data
PC	Composite of power 120 to 600V and control

F	Optical Fiber
PSP, CSP	Spare power, spare control

- C. RACEWAY NUMBERS: Where circuit/raceway numbers have not been assigned, Contractor shall assign raceway numbers in accordance with the system outlined in the drawings.

1.11 CONDUCTOR NUMBERS:

- A. WIRE MARKERS: All control and signal conductors in panels, pull boxes, power, instrument, and relay compartments of motor control centers, control cabinets, instrument cabinets, field cabinets and control stations, as well as connections to mechanical equipment, shall be tagged at each end with legible, coded tight-fitting wire-marking sleeve showing the complete wire designation. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink. The figures shall be 1/8 inch high. Sleeves shall be yellow or white tubing, sized to fit the conductor insulation. The sleeves shall be shrunk to fit the conductor with hot air after installation. They shall be T&B, SHRINK-KON HVM or equal. Adhesive strips are not acceptable. Conductors size No. 10 AWG or smaller shall have identification sleeves. Conductors No. 8 AWG and larger shall use cable markers of the locking tab type. Tabs shall be white plastic with conductor identification number permanently embossed.
- B. INTERNAL WIRING:
1. Wiring within a single enclosure shall be marked with the basic wire and terminal number at each end. The wire number shall designate the terminal or equipment number at each end of the wire separated by a slash.
 2. Wiring within MCC buckets shall have a simple numbering scheme, and shall use the same number at each end. (1,2,3,4,5, etc.) Wiring which lands on field terminals shall utilize the terminal number for the internal wire number.
- C. FIELD WIRING: All field wiring shall have wire labels at each end. The labels shall be marked with the output terminal number at the original equipment (local control panel or MCC) and the remote device terminal # (if applicable) and tag name separated by a slash. Conductors shall be identified with numbers at both ends. Conductor tag numbers shall be the conductor number specified on the control diagram or if not shown, shall follow the convention below.
1. Wires from MCC buckets shall be labeled with [MCC number (086) - bucket number(A4) - terminal number (6)] (MCC3-A4-6)

2. Wires from Local Control Panels shall be labeled with panel number (PNL2000)-terminal number (12)] (PNL2000-12)
 3. Wires from PLC panels or remote I/O panels shall have Rack or Bus (1) – Card or Block (7) -Terminal number(A3) only (1-7-A3)
 4. Wires from devices, instruments etc. shall have the instrument or device name and terminal number if applicable. Equipment name is typically DEVICE TYPE - NUMBER. (HS2510) (TSH2510) (FIT2562)
- D. EXAMPLE for a control cable from the Area Control Panel PNL2000 bus 1, block 1, terminal A4 to the level transmitter (LIT2501) - the wire tag number at both ends shall be LIT2501 / 1-1-A4. (Do not include the panel name, just the bus, block, terminal number.)
- E. EXAMPLE for a control cable from the Area Control Panel PNL2000 rack 4, card 5, terminal A4 to the MCC3, bucket D5 terminal 6 the tag number at both ends shall be MCC3-D5-6/4-5-A4
- F. EXAMPLE for a control cable from the MCC3 bucket A4 terminal 12 to device HS4030, the wire tag number at both ends shall be MCC3-A4-12 / HS4030. (Do not include the system abbreviation on devices connected to an MCC bucket.)

1.12 INDICATING LAMP COLORS

- A. All indicating lamps shall have an integrated lamp-test function for all lamps on a single line-up of equipment (i.e. Motor Control Center, Switchgear).
- B. Unless otherwise specified, indicating lights shall be equipped with colored lenses in accordance with the following schedule:

Color	Function	Example
Green	Run, open valve	Equipment operating, motor running
Red	Stopped, Closed valve	Alarm, end of cycle, motor stopped
White or clear	Normal condition, Ready	Control power on, status OK
Amber (yellow)	Abnormal condition	Failure of equipment or status abnormal, fault condition
Green	Breaker Open	Switchgear breaker illuminated pushbutton
Red	Breaker Closed	Switchgear breaker illuminated pushbutton

Amber (yellow)	Breaker Tripped	Switchgear breaker illuminated pushbutton
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1.13 EQUIPMENT COORDINATION

- A. The Contractor is responsible to coordinate the equipment supplied from various manufacturers and vendors. This includes but is not limited to:
1. Obtaining specific information on equipment ratings and sizes and verifying the electrical components supplied meet, or match the requirements such as voltage, phase, frequency, starter types, etc.
 2. Shall provide equipment that will fit within the space allocated and meet OSHA and NEC clearances.
 3. Shall provide coordinated electrical installations with the supplied equipment's electrical power and control requirements.
 4. Shall provide power and control equipment, wiring, and raceways to meet the requirements of the mechanical equipment supplied.
 5. Shall provide all necessary control wiring and components for any special requirements from an equipment manufacturer.
- B. The Contractor shall verify as a minimum:
1. Correct voltage, phase and frequency
 2. Size and space requirements
 3. Mounting requirements
 4. Correct motor starter type and NEMA size
 5. Proper coordination with the controls and control System Integrator
- C. Any discrepancies between the electrical equipment and other equipment shall be brought to the immediate attention of the Owner.
- D. The Contractor shall assure that no instrumentation or control interferences are created by the variable frequency drives (VFDs) or load wiring. The Contractor shall coordinate with the VFD manufacturer to provide necessary separation of conductors or shielding and/or filtering equipment as required by the VFD manufacturer. If interferences do occur, the Contractor shall be responsible to take corrective action at no additional cost to the Owner.
- E. WIRING FOR VENDOR PACKAGES:
1. Equipment specifications indicate when the Vendor is responsible for providing interconnection wiring between components of a Vendor package that are

installed on separate skids or assemblies. In this circumstance, interconnection wiring between skids or assemblies in a Vendor package is scheduled as "Vendor Wiring" in the conduit/cable schedules.

2. Where equipment specifications do not specify Vendor furnished wiring between skids or assemblies in a Vendor package, the Contractor shall provide and install interconnection wiring between skids or assemblies per the Vendor's interconnection wiring requirements. Interconnection wiring between skids or assemblies in a Vendor package that is furnished and installed by the Contractor is not scheduled in the conduit/cable schedules.
3. Determination of cable requirements.
 - a. Coordinate cable/conductor requirements with the selected Vendors to determine the correct wiring required to interconnect the package system components/skids.
 - b. Wiring between Vendor furnished components shipped on separate skids or assemblies shall conform to requirements specified in Division 25 and Division 26.
 - c. Wiring between the plant control system and Packages system components/skids are specified in the conduit/cable schedules.
 - d. Wiring between external power supplies and the packaged system components/skids are specified in the conduit/cable schedules.
4. Assign numbers and tagging for unscheduled raceway, and cable between Vendor furnished components on separate skids or assemblies as specified in Section 26 05 00. Coordinate this information in submittals, record drawings, and O&M manuals provided under this contract.
5. Contract documents shall be updated in the record drawing set to include the work provided for wiring the vendor packages.

1.14 BASIS OF DESIGN

- A. The basis of the mechanical and electrical design is the installation of equipment and motors as shown in the electrical one-line drawing(s) and load/panel schedules. In the event that different equipment motors are provided in order for the vendor's equipment to meet mechanical performance requirements, the contractor shall coordinate various suppliers, vendors, and subcontractors to change the required electrical conduit, cables, breakers, motor control center sections, starters units and accessories, etc. as necessary to meet the vendor's equipment installation requirements of the National Electrical Code. The traits and characteristics of all provided materials, equipment, and devices shall meet the specifications. These

changes to materials, equipment, and devices shall be at no cost to the Owner. Electrical submittal information shall be coordinated with the equipment and motors provided.

1.15 ARC FLASH MITIGATION METHODS

- A. The following mitigation method requirements shall apply to all power distribution and utilization equipment supplied for any products supplied on the project and applies to all equipment divisions in the Contract Documents. Refer to the NFPA-70 (NEC) and NFPA-70E (Electrical Safety in the Workplace) for equipment labeling requirements.
1. EQUIPMENT LABELS: Equipment labels shall be installed on the outside of the electrical equipment enclosure, cabinet, and panels to avoid opening the equipment to access the manufacture's data or the equipment ratings.
 2. HINGED DOORS: Power distribution equipment shall have hinged rear doors where back access is shown.
 3. REMOTE RACKING DEVICES: Switchboard SWBD-2 shall be provided with a remote racking device for Electricians to insert or remove rack-mounted breakers, rack-mounted devices, or auxiliary equipment drawers in- to the associated equipment location.
 4. INSULATED POWER BUS AND INSULATED CABLE BOOTS:
 - a. Provide insulated power bus in power distribution equipment where accessible to installers or maintenance workers.
 - b. Provide cable boots for power conductor connections to insulate the exposed power conductor connections.
 5. VIEW WINDOWS FOR MONITORING: Provide protected view windows into cabinets that allow infra-red analyzers, monitors, or cameras to monitor hot temperature for unusual heat generated by deteriorating connections. The view windows shall have a method to move the window protector and hold- in-place during the monitoring operation.
 6. POWER AND CONTROL EQUIPMENT SEPARATION:
 - a. Provide separation between power equipment within an enclosure, cabinet, or panel by the use of barriers, separate access doors, or by other means.
 - b. Provide separation barriers between main breaker feeders coming in- to equipment and other termination points or bussing on the load side of the main breaker.

7. AUTOMATIC SHUTTERS: Provide automatic shutters, where possible, to close the access to the power bus when a power device is not engaged.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. GENERAL: Equipment and materials shall be new and free from defects. All material and equipment of the same or a similar type shall be of the same manufacturer throughout the work. Standard production materials shall be used wherever possible.
- B. EQUIPMENT FINISH: Unless otherwise specified, electrical equipment shall be painted by the manufacturer as specified in Section 09 90 00.
- C. GALVANIZING: Where specified, galvanizing shall be in accordance with Section 05 50 00.

2.2 WIRE MARKERS

- A. Each power and control conductor shall be identified at each terminal to which it is connected. Conductors size No. 1 AWG or smaller shall have identification sleeves. Conductors No. 2 AWG and larger shall use cable markers of the locking tab type. Tabs shall be white plastic with conductor identification number permanently embossed.
- B. Conductors shall be identified in accordance with Section 26 05 00. Adhesive strips are not acceptable.
- C. The letters and numbers that identify each wire shall be machine printed on sleeves with permanent black ink with figures 1/8 inch high. Sleeves shall be yellow or white tubing and sized to fit the conductor insulation. Shrink the sleeves with hot air after installation to fit the conductor.
- D. Conductor and Wire Marker Manufacture:
 1. TMS Thermofit Marker System by Raychem Co
 2. Sleeve style wire marking system by W. H. Brady Co.
 3. Or approved equal

2.3 MC-HL CABLE AND RACEWAY TAGS

- A. Tags shall be:
 1. Manufactured of permanent metal or heavy mill plastic.

2. Fastened to the raceways at both ends of the tag with permanent fasteners.
 - a. Fastened to the raceways at both ends of the tag with permanent fasteners.
3. Tag numbers shall be 1-inch tall and machine printed. Hand labeled tags are unacceptable.

2.4 NAMEPLATES

- A. Nameplates shall be provided on all electrical devices, including but not limited to motor control equipment, MCC cubicles/cells/buckets, control stations, junction boxes, panels, harmonic filters, instruments, disconnect switches, indicating lights, meters, and all electrical equipment enclosures.
- B. Nameplates shall also be provided on all electrical panel interior equipment, including but not limited to relays, circuit breakers, power supplies, terminals, contactors, and other devices.
- C. Equipment nameplates shall have both the equipment name and number.
- D. Nameplates shall be made of 1/16-inch-thick machine engraved laminated phenolic having black letters not less than 3/16" high on white background or as shown on the drawings or other sections of the specifications. Nameplates on the interior of panels shall be White Polyester with printed thermal transfer lettering and permanent pressure sensitive acrylic; TYTON 822 or approved equal. All nameplates shall include the equipment name and number (and function, if applicable).
- E. Provide warning nameplates on all panels and equipment which contain multiple power sources. Lettering shall be white on red background.
- F. Nameplates shall be secured to equipment with stainless steel screws/fasteners.
- G. Nameplates for disconnect switches shall contain name and number as well as voltage, phases and colors of conductors.

2.5 TERMINAL BLOCKS

- A. GENERAL:
 1. Terminal Blocks for all contractor supplied equipment and devices shall be manufactured by Allen Bradley, Bussmann, Phoenix Contact, or approved equal.
 2. Unless otherwise specified, terminal blocks shall be panhead strap screw type. Terminals shall be provided with integral marking strips which shall be permanently identified with the connecting wire numbers as shown on the drawings. Terminal blocks for P-circuits (power 120-600 volts) shall be rated not less than the

conductor current rating and shall not be rated less than 600 volts AC. Terminal blocks for C-circuits (control and/or control power 120 volts or less) and S-circuits (signal) shall be rated not less than 20 amperes and shall not be rated less than 600 volts AC. Terminals shall be tin-plated. Insulating material shall be nylon. Terminal blocks shall be in accordance with section 26 27 16 for all electrical equipment.

3. Provide terminals for all wire connections to field wiring and internal power distribution. Analog loops that are 24 VDC powered shall have a knife switch to disable the loop if necessary.
 4. Connections shall have compression terminals capable of terminating 2 #14 AWG stranded wires. Terminals shall be DIN rail strip mounted as manufactured by Phoenix Contact, or approved equal. Provide number strips for terminal blocks that are referenced by the wire marker. Provide bridge bars for jumpers between terminal blocks. Provide end clamps to separate and terminate terminal block groups. Provide end covers for groups of terminal blocks in sets to match the number points associated with individual I/O cards in the PLC block.
 5. Provide Separation Plates on each side of terminals that are at a different potential or polarity than surrounding terminals.
 6. Provide clear plastic DIN rail mounted nametag stanchions for each block of terminations. Each nametag shall hold a preprinted label designating the PLC bus and PLC block that terminates to that set of terminals.
 7. Terminals shall be mounted such that there is a minimum of 1.5 inches of clear space on both sides of the terminal; for ease of wiring.
 8. Mount all terminals strips on 2-inch standoffs.
 9. Provide 10 spare terminals or 5% whichever is the greater amount, spare (non-installed) replacement terminals for each type used.
 10. Provide wired terminals to match the number of points supplied on each installed I/O card or spare slot in a PLC cabinet.
- B. DIGITAL TERMINALS:
1. Terminal Blocks for use in general purpose and digital input terminations shall be Phoenix Contact UK 5, or approved equal. Provide double high terminals for general purpose.
 2. Where space is limited for the required number of digital input points double high terminals are permitted if first approved by the Owner.
- C. ANALOG TERMINALS:

1. Terminal Blocks for use in analog input terminations shall be knife disconnect, with socket for analog isolator Phoenix Contact URELG-PMTK, or approved equal.
2. Terminal blocks for analog outputs shall be fused, double high with a separate ground terminal.
3. The wire used for analog inputs and outputs shall be multi-conductor #18 twisted pairs with an overall shield. Provide 4 & 8 pairs to match the input or output cards. Wire pairs shall be numbered and colored red for + and black for -. Use BELDEN-M 9520 CMG or approved.

D. FUSED TERMINALS:

1. Fuse terminal blocks shall be hinged disconnect level type with "blown fuse" indicators. PHOENIX CONTACT UK 5 HESI series, or approved equal.

PART 3 EXECUTION

3.1 GENERAL

A. CONSTRUCTION

1. The work under Division 26 shall be performed in accordance with these specifications.
2. Unless otherwise detailed or dimensioned, electrical layout drawings are diagrammatic. The Contractor shall coordinate the field location of electrical material or equipment with the work of other disciplines and subcontractors. Minor changes in location of electrical material or equipment made prior to installation shall be made at no cost to the Owner.
3. The Contractor shall perform core drilling required for installation of raceways through concrete walls and floors. Locations of floor penetration, as may be required, shall be based on field conditions. Verify all exact core-drilling locations based on equipment actually furnished as well as exact field placement.
4. The Contractor shall seal all roof penetrations in accordance with approved sealing means.

B. HOUSEKEEPING:

1. Electrical equipment shall be protected from dust, water and damage. Motor control centers, switchgear, and buses shall be wiped free of dust and dirt, kept dry, and shall be vacuumed on the inside within 30 days of acceptance of the work.

2. Before final acceptance, the Contractor shall touch up any scratches on equipment as specified in Section 09 90 00.
 3. Electrical equipment temporarily exposed to weather, debris, liquids, or damage during construction shall be adequately protected.
- C. ELECTRICAL EQUIPMENT LABELING:
1. Electrical equipment shall have field marked signs and labeling to warn qualified persons of the potential electric arc flash hazards per NEC Article 110.16 Flash Protection.
 2. Electrical equipment shall have NFPA 70E labels installed stating the results of the Arc Flash analysis specified in Section 26 05 73.
 3. Electrical distribution equipment and utilization equipment shall be provided with field labels to identify the power source and the load as specified. Refer to NEC Article 110.22 for Identification of Disconnecting Means installation criteria. Specific information is required such as the equipment tag number and equipment description of both the power source and the load equipment.
- D. MOTOR CONNECTIONS: Verify that the motors are purchased with the correct size motor termination boxes for the circuit content specified in the conduit and cable schedules or submit custom fabrication drawing indicating proposed motor termination box material, size, gasket, termination kit, grounding terminal, boot type insulated motor lead connection (T&B type MSC, or approved equal), and motor terminal box connection/support system. Verify the motor termination box location prior to raceway rough-in.
- E. CONDUCTOR INSTALLATION: An enclosure containing disconnecting means, overcurrent devices, or electrical equipment shall not be used as a wireway or raceway for conductors not terminating within the enclosure. Provide wireways, raceways, termination boxes, or junction boxes external to the enclosure for the other conductors.

3.2 DELIVERY, STORAGE AND HANDLING

- A. PROCEDURES: Section 01 66 00
- B. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manual. One (1) copy of this document shall be provided with the equipment at the time of shipment.
- C. 'Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

3.3 TESTING

- A. GENERAL: Prior to energizing the electrical circuits, insulation resistance measurements tests shall be performed using a 1000-volt megohmmeter to verify the conductor is acceptable for use on the project. The test measurements shall be recorded on the specified forms and provided in accordance with Section 26 08 00 and 26 05 00.
- B. INSULATION RESISTANCE MEASUREMENTS:
 - 1. GENERAL:
 - a. Insulation resistance measurements shall be made on conductors and energized parts of electrical equipment (600V or less). Minimum acceptable values of insulation resistance shall be in accordance with the applicable ICEA, NEMA or ANSI standards for the equipment or material being tested, unless otherwise specified. The ambient temperature at which insulation resistance is measured shall be recorded on the test form.
 - b. Insulation resistance measurements shall be recorded. Insulation with resistance of less than 10 megohms is not acceptable.
 - 2. CONDUCTOR AND CABLE TESTS: The phase-to-ground insulation resistance shall be measured for all circuits rated 120 volts and above except lighting circuits. Measurements may be made with motors and other equipment connected. Solid state equipment shall be disconnected, unless the equipment is normally tested by the manufacturer at voltages in excess of 1000 volts DC.
 - 3. MOTOR TESTS: Installed motors shall be tested per Section 26 08 00 shall be completed for each motor after installation. Motors shall have their insulation resistance measured before they are connected. Motors 50 HP and larger shall have their insulation resistance measured at the time of delivery as well as when they are connected. Insulation resistance values less than 10 megohms are not acceptable.
- C. PRE-FUNCTIONAL TEST CHECKOUT: Functional testing shall be performed in accordance with the requirements of Section 26 08 00. Prior to functional testing, all protective devices shall be adjusted and made operative.
 - 1. Submit a description of the proposed functional test procedures prior to the performance of functional checkout.
 - 2. Prior to energization of equipment, perform a functional checkout of the control circuit. Checkout:
 - a. Energizing each control circuit.

- b. Operating each control device, alarm device, or monitoring device.
- c. Operate each interlock to verify that the specified action occurs.
- D. Verify motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor, provided the Contractor confirms that neither the motor nor the driven equipment will be damaged by reverse operation or momentary energization.

3.4 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable switches and circuit-breaker trip ranges.

3.5 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.6 OPERATION AND MAINTENANCE MANUALS

- A. Comply with Section 01 77 00 - Project Closeout 01 78 23 - Operations and Maintenance Data and Part 1 of this specification.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE CONDUCTORS, WIRES AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Reference Standards.
 3. Quality Assurance.
 4. Definitions.
 5. Submittals.
 6. Products.
 7. Execution.

1.2 SCOPE

- A. This section specifies cables, conductors and fibers including:
1. Stranded copper cables, conductors, and wire rated 600 volts insulation used for power; lighting, analog, digital, or pulse signals and control circuits.
 2. Copper cables and coax cable rated 300-volt insulation used for data, communication, and signaling.
 3. Fiber optic data cable used for data communication.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
1. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall

mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ASTM B3	Soft or Annealed Copper Wire
ASTM B8	Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	Tinned Soft or Annealed Copper Wire for Electrical Purposes
ICEA S-95-658/ NEMA WC70	Non-shielded 0-2kV Cables
NFPA 70	National Electric Code (NEC)
IEEE 383	Type Test of Class IE Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations
UL 44	Rubber-Insulated Wires and Cables
UL 83	Thermoplastic-Insulated Wires and Cables
ANSI X3.166	Information Systems--Fiber Data Distributed Interface (FDDI)--Token Ring Physical Layer Medium Dependent (PMD)
EIA RS232D	Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data
EIA RS422	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA RS485	Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems
IEEE 802	IEEE Standards for Local and Metropolitan Area Networks: Overview and Architecture
IEEE 802.3	Information Processing Systems--Local and Metropolitan Area Networks--Part 3: Carrier Sense Multiple Access with Collision
IEEE 802.3k	Supplement to ISO/IEC 8802-3, Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical
IEEE 802.4	Information Processing Systems--Local Area Networks--Part 4: Token-Passing Bus Access Method and Physical Layer
ANSI/NFPA 72	Installation, Maintenance, and Use of Protective Signaling Systems
ANSI/NFPA 72H	Testing Procedures for Signaling Systems

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from the date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 DEFINITIONS

- A. LOW LEVEL ANALOG: A signal that has a full output level of 100 millivolts or less. This group includes thermocouples and resistance temperature detectors.
- B. DATA OR DIGITAL CODE: Coded information such as that derived from the output of an analog to digital converter or the coded output from a digital computer or other digital transmission terminal. This type includes those cases where direct line driving is utilized, such as EIA RS422.
- C. PULSE FREQUENCY: Counting pulses such as those emitted from speed transmitters.
- D. HIGH LEVEL ANALOG: Signals with full output level greater than 100 millivolts but less than 30 volts, including 4-20 mA transmission.
- E. MODULATED SIGNALS: Signals emanating from modems or low-level audio signals. Normal signal level is plus 4 dBm to minus 22 dBm. Frequency range is 300 to 10,000 hertz.
- F. DISCRETE EVENTS: Dry contact closures monitored by solid state equipment. If the conductors connecting to dry contacts enter enclosures containing power or control circuits and cannot be isolated from such circuits in accordance with NEC Article 725, this signal shall be treated as low voltage control.
- G. LOW VOLTAGE CONTROL: Contact closures monitored by relays, or control circuits operating at less than 30 volts and 250 milliamperes.
- H. HIGH LEVEL AUDIO SIGNALS: Audio signals exceeding plus 4 dBm, including loudspeaker circuits.
- I. RADIO FREQUENCY SIGNALS: Continuous wave alternating current signals with fundamental frequency greater than 10 kilohertz.

1.6 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.

4. Catalog cuts showing information of the conductors and cables to be supplied under this section.
5. Field test reports showing conductor and cable insulation resistance test results.
6. Provide engineering pull calculations for all 600V main feeders run underground outside building footprints.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers are listed in the Cable Specification Sheets located at the end of this specification section.

2.2 GENERAL

A. UNSCHEDULED CONDUCTORS AND CABLES:

1. With the exception of lighting and receptacle circuits, the type, size and number of conductors shall be as specified on the drawings or schedules. 120V panel circuit conductors mentioned above that are unscheduled and shall be sized by the Contractor in accordance with the breakers specified and the NEC to limit voltage drop to 3 percent. Minimum size of power, lighting, and receptacle circuits shall be 12 AWG. Number and types of communication, paging, and security cables shall be as required for the particular equipment provided. Power, lighting, and receptacle circuit conductors shall be provided in accordance with CABLESPEC "XHHW," unless otherwise specified.
2. Where not specified on the Drawings, conductors and cables shall be sized in accordance with the National Electrical Code for the particular equipment served with the minimum size as specified herein. Unscheduled conductors shall be sized by the Contractor in accordance with NEC tables and to limit voltage drop to 3 percent.
3. Unscheduled conductors with insulation shall be provided in accordance with the CABLE SPECIFICATIONS in TABLE 2 according to the purpose.

- B. CABLE SPECIFICATION SHEETS (CABLESPEC): General requirements for conductors and cables specified in this Section are listed on CABLESPEC sheets.

2.3 COLOR CODING

A. POWER AND CONTROL CABLES:

1. Wire coloring shall conform to the color code shown in the table below.
2. Insulation on phase conductors run in conduits sizes #10 AWG and smaller shall be colored, #8 AWG and larger may have black insulation with plastic tape of the appropriate color from the table below.
3. Insulation on the grounded conductor (neutral) sizes #8 AWG and smaller shall be colored, #6 AWG and larger may have black insulation with plastic tape of white or gray in accordance with the table below.

Description	120/208V	277/480V	Control
Phase A (Left)	Black	Brown	--
Phase B (Center)	Red	Orange	--
Phase C (Right)	Blue	Yellow	--
Neutral	White	Gray	White
Ground	Green	Green	Green
120 VAC Control	--	--	Red
120 VAC Control Neutral	--	--	White
DC Control (+)	--	--	Blue
DC Control (-)	--	--	White-Blue Stripe
Signal (+)	--	--	Red
External Source	--	--	Yellow
Computer/Signal Ground	--	--	Green/yellow stripe

4. All control wiring in control panels or other enclosures that is powered from an external source and is not disconnected by the control panel disconnect shall be terminated at a disconnecting terminal block upon entering the enclosure. The color of the wire shall then be changed to yellow to identify it as being powered from an external source. Provide identification nameplate on exterior of enclosure to indicate sources of external power.
5. All wiring in industrial machines and equipment shall be in accordance with NFPA 79. Notify owner of any deficiencies noted during installation.
6. Multi-conductor power cable colors shall be manufacturer's standard.
7. Cables sized No. 6 AWG and larger may be black with colored 3/4-inch vinyl plastic tape applied in 3-inch lengths around the cable at each end. The cables shall be tagged at terminations and in pull boxes, hand holes and manholes.

- B. SIGNAL AND DATA CABLES: Unless otherwise specified, cables shall be color coded black and white for pairs or black, red, and white for triads.

2.4 POWER AND CONTROL CONDUCTORS AND CABLE, 600 VOLT

- A. SINGLE CONDUCTOR: Single conductor cable shall be stranded copper and shall be used in conduits for power and control circuits. Single conductor cable shall be provided in accordance with CABLESPEC "XHHW" type of conductors unless otherwise specified.
- B. MULTI-CONDUCTOR CABLE: Provide multi-conductor power cable and multi-conductor control cable where identified on the drawings. Multi-conductor cables shall be in accordance with CABLESPEC "TC" type cables.

2.5 SIGNAL, DATA AND INSTRUMENTATION CABLES

A. GENERAL:

1. Signal cable shall be provided for instrument signal transmission, alarm, communication, and other circuits as specified. Circuit shielding shall be provided in addition to cable shielding.
2. Single circuit signal cable shall be provided in accordance with CABLESPEC "INS," unless otherwise specified for hazardous locations type "SP-OS" (ITC/PLTC). Multi-circuit signal cable shall be provided in accordance with CABLESPEC "INS/M," unless otherwise specified for hazardous locations type "SP-OS" (ITC/PLTC).
3. Terminal blocks shall be provided at cable junction for running signal leads and shield drain wires. Each conductor shall be identified at such junctions.
 - a. Shields shall not be used as a ground path.
 - b. Shields shall be grounded at one end only. Refer to I drawings for grounding location.
 - c. Signal, data, and communication cables shall be terminated and spliced on terminal strips properly mounted and labeled in accordance with this Section and Section 26 05 00. No exceptions.
4. CABLE SPECIFICATION SHEETS (CABLESPEC): General requirements for conductors and cables specified in this Section are listed on CABLESPEC sheets in Section 26 05 19-3.07.

- B. FIBER OPTIC CABLE: Fiber optic cable shall be Multi Mode as shown on the drawings and as specified in the CABLESPEC descriptions.

- C. COMMUNICATION, PAGING, AND SECURITY SYSTEM CABLES: Voice communication, paging, and security system cables shall be specified in their respective specification sections.

2.6 WIRE MARKERS

A. 600 VOLT AND 300 VOLT RATED CONDUCTORS:

1. Per 26 05 00 Paragraph 2.2.

B. FIBER OPTIC:

1. Provide Markers for labeling each end of a fiber optic cable. Fiber optic markers must have space for typed or machine printed text.
2. Provide Markers for Individual fiber optic strands, jumpers, and patch cables. Fiber optic markers must have space for typed or machine printed text. Fiber optic markers shall be attached to the fiber using tie wrap or other approved method of securing the marker Listed.

2.7 SPlicing AND TERMINATING MATERIALS

A. 600-VOLT AND 300-VOLT RATED CONDUCTORS:

1. Connectors shall be tool applied compression type of correct size and UL listed for the specific application. Connectors shall be tin-plated high conductivity copper. Connectors for wire sizes No. 10 AWG and smaller shall be nylon self-insulated, ring tongue or locking-spade terminals. Connectors for wire sizes No. 8 AWG and larger shall be one-hole lugs up to size No. 3/0 AWG, and two-hole or four-hole lugs for size No. 4/0 and larger. Mechanical clamp, dimple, screw-type connectors are not acceptable.
2. In-line splices and taps shall not be used. All circuits shall be continuous through all junction boxes, wireways, pull boxes, etc. until the circuit conductors are terminated at suitable terminal strips within motor control centers, PLC cabinets and panels, distribution panels, local control stations, etc.
3. Motor terminations at 460-volt motors shall be made by bolt-connecting the lugged connectors. Connections shall be insulated with Thomas and Betts (T&B), MSC series Motor Stub Splice Insulators and sealed with the appropriate tape for the motor voltage. (Example 480V = Scotch 33)

2.8 CORD GRIPS

- A. Cord grips shall be provided where specified on the Drawings to attach flexible cord to equipment enclosures. Cord grips shall consist of a threaded aluminum body and

compression nut with a neoprene bushing and stainless-steel wire mesh for strain relief. Cord grip shall provide a watertight seal at enclosure interface and sized to accommodate the flexible cord.

2.9 VFD WIRING

- A. Shielded power cables (TYPE VFD2/3) shall be used for load-side wire between the VFDs and the motors.

PART 3 EXECUTION

3.1 GENERAL

- A. Conductors shall be identified at each connection terminal and at splice points. The identification marking system shall comply with Section 26 05 00.
- B. Pulling wire and cable into conduit or trays shall be completed without damaging or putting undue stress on the insulation or jacket. Manufacture recommended and UL Listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable.
- C. Raceway construction shall be complete, cleaned, and protected from the weather before cable is installed. Where wire or cable exits a raceway, a wire or cable support shall be provided.
- D. Provide tin-plated bus bar. Scratch-brush the contact areas and tin plate the connection where flat bus bar connections are made with un-plated bar. Bolts shall be torqued to the bus manufacturer's recommendations.

3.2 600-VOLT CONDUCTOR AND CABLE

- A. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing is not necessary in plastic panel wiring duct or wall mounted steel raceway used above countertops. Lacing shall be made up with plastic cable ties. Cable ties shall be tensioned and cut off by using a tool specifically designed for the purpose such as a Panduit GS2B. Other methods of cutting cable ties are unacceptable.
- B. Conductors crossing hinges shall be bundled into groups not exceeding 10 to 15 conductors and protected using nylon spiral flexible covers to protect conductors. Provide oversized plastic panel wiring duct within panels and panelboards.
- C. Slack shall be provided in junction and pull boxes, hand holes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls. Amount of slack shall be equal to largest dimension of the enclosure. Provide dedicated electrical

wireways and insulated cable holders mounted on unistrut in manholes and hand holes.

D. Raceway fill limitations shall be as defined by NEC and the following:

1. Lighting and receptacle circuits may be in the same conduit in accordance with de-rating requirements of the NEC. Lighting and receptacle circuits shall not be in conduits with power or control conductors. Signal conductors shall be in separate conduits from power and control conductors. Motor feeder circuits shall be in separate conduits including small fan circuit unless combination fan-light fixture.
2. Power conductors derived from uninterruptible power supply systems shall not be installed in raceways with conductors of other systems. Install in separate raceways.
3. Splices and terminations are subject to inspection by the Owner prior to and after insulating.
4. Motor terminations at 460-volt motors shall be made by bolt-connecting the lugged connectors.
5. In-line splices and tees, where approved by the Owner, shall be made with tubular compression connectors and insulated as specified for motor terminations. Splices and tees in underground hand holes or pull boxes shall be insulated using Scotch-cast epoxy resin or Raychem splicing kits.
6. Terminations at solenoid valves, 120-volt motors, and other devices furnished with pigtail leads shall be made using self-insulating forked compression connectors and terminal strips within a termination/junction box.
7. Terminations at valve and gate motor actuators shall be made directly into the actuator where possible. Power termination shall be made in the actuator power disconnect. Control and signal cable may be routed to a termination box near the actuator on 20-ampere rated terminal strips with label identification for the control and signal conductors. Single wire control conductors and analog cable (INS or INS/M) then installed in flexible conduit to the actuator control and signal termination compartments.
8. Solid wire shall not be used.
9. Sharing neutrals for power circuits is unacceptable.
10. Conductor and cable markers shall be provided at splice points.

3.3 SIGNAL CABLE

- A. Circuits shall be run as individually shielded twisted pairs or triads. In no case shall a circuit be made up using conductors from different pairs or triads. Triads shall be used wherever 3-wire circuits are required. Terminal blocks shall be provided at instrument cable junctions, and circuits shall be identified at such junctions unless otherwise specified. Signal circuits shall be run without splices between instruments, terminal boxes, or panels.
- B. Shields shall not be used as a signal conductor.
- C. Common ground return conductors for two or more circuits are not acceptable.
- D. Unless otherwise specified, shields shall be bonded to the signal ground bus at the control panel and isolated from ground and other shields at other locations. Terminals shall be provided for running signal leads and shield drain wires through junction boxes.
- E. Cable for communication systems shall be installed and terminated in compliance with the equipment manufacturer's recommendations and applicable NEC requirements.
- F. Cable for data circuits and operating at greater than 10 kHz, shall be run continuously from node to node without splices or intermediate terminal blocks unless otherwise specifically specified or shown.
- G. Cable for low-level instrumentation circuits shall be run continuously between final terminations without splices or intermediate terminal blocks unless otherwise specifically shown or specified.
- H. Spare circuits and the shield drain wire shall be terminated on terminal blocks at both ends of the cable run and be electrically continuous through terminal boxes. Shield drain wires for spare circuits shall not be grounded at either end of the cable run.
- I. Terminal boxes shall be provided at instrument cable splices. If cable is buried or in raceway below grade at splice, an instrument stand shall be provided as specified with terminal box mounted approximately 3 feet above grade.

3.4 INSTALLATION

- A. Raceway fill shall be as scheduled, and shall not exceed NEC limitations.
- B. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:
 - 1. Where specifically indicated on the drawings.

2. Where field conditions dictate and written permission is obtained from the Owner.
 3. Control circuits shall be isolated from the feeder and branch power and instrumentation circuits but combining of control circuits with power is permitted as noted below.
 - a. The combinations shall comply with the following:
 - 1) 12 VDC, 24 VDC and 48 VDC may be combined.
 - 2) 125 VDC shall be isolated from all other AC and DC circuits.
 - 3) All AC circuits shall be isolated from all DC circuits.
 4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
 - a. The combinations shall comply to the following:
 - 1) Analog signal circuits may be combined.
 - 2) Digital circuits may be combined but isolated from analog signal circuits.
 5. Multiple branch circuits for lighting, receptacle and other 120 VAC circuits are allowed to be combined into a common raceway.
 - a. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NEC, including but not limited to:
 - 1) Up sizing conductor size for required Ampacity de-ratings for the number of current-carrying conductors in the raceway.
 - 2) The neutral conductors may not be shared.
 - 3) Up sizing raceway size for the size and quantity of conductors.
- C. Pulling wire and cable into conduit or cable trays shall be completed without damaging or putting undue stress on the cable insulation. Only UL listed pulling compounds are acceptable lubricants for pulling wire and cable. Grease is not acceptable. Raceway construction shall be complete, cleaned, and protected from the weather before cable is placed.
- D. Whenever a cable leaves a raceway, a cable support shall be provided. Conductors in panels and electrical equipment shall be bundled and laced at intervals not greater than 6 inches, spread into trees and connected to their respective terminals. Lacing shall be made up with plastic cable ties. Lacing is not necessary in plastic panel wiring

duct. Conductors crossing hinges shall be bundled into groups not exceeding 12 and shall be so arranged that they will be protected from chafing when the hinged member is moved.

- E. Slack shall be provided in junction and pull boxes, hand holes and manholes. Slack shall be sufficient to allow cables or conductors to be routed along the walls of the box. Amount of slack shall be equal to largest dimension of the box. Where plastic panel wiring duct is provided for wire runs, lacing is not required. Plastic panel wiring duct shall not be used in manholes and hand holes.
- F. Do not exceed cable manufacturer's maximum recommended pulling tension. Use dynamometer or break-away swivel on pulls exceeding 150 feet.
- G. Observe manufacturer's minimum recommended pulling and training radii.
- H. Where data cables are installed in cable trays, provide barriers in the tray to separate data cables from power and/or control cables.
- I. At each end of the run leave sufficient cable for termination. Coil sufficient cable in each manhole, handhold, or pull box to permit future splice.
- J. In-line splices and tees are not allowed.
- K. Splices shall not be permitted in any coaxial, twin-axial, or data cable runs.
- L. Ground cable shields at one end only. Unless otherwise specified, ground the shields at the panel end.
- M. Protect all cables against moisture during and after installation.
- N. Install and ground token passing bus cable in accordance with IEEE 802.4. Attach trunk cable to walls and ceilings with PVC clamps with clamp backs at 4-foot intervals.
- O. Install and ground Ethernet cable in accordance with IEEE 802.3. Attach trunk cable to walls and ceilings with PVC clamps with clamp backs at 4-foot intervals.
- P. Signal and control cable suspended into the wet well shall be provided with heavy duty wire mesh cord grip of flexible stainless-steel wire to take the tension from the cable termination. Strain relief system shall be suitably anchored.
- Q. Circuits provided under this Section shall not be direct buried.

3.5 TERMINATIONS

- A. Terminations shall be on terminators as identified in Section 26 05 00.

- B. Each conductor shall be identified with a wire marker at each terminal to which it is connected. The marking system shall comply with Section 26 05 00.
- C. Stranded conductors shall be terminated as described in Section 26 05 19, except where terminals will not accept such terminations. Compression lugs and connectors shall be installed using manufacturer's recommended tools. Where terminal blocks will not accept lugged conductors, the conductors shall be tinned using 60 percent tin, 40 percent lead alloy non-corrosive resin core solder before insertion into pressure terminals.
- D. Electrical spring connectors (wire nuts) shall not be used for any purpose on any cable specified under this Section except for receptacle and lighting circuits. Lugs and connectors shall be installed with a compression tool.
- E. All splices and terminations are subject to inspection by the Owner prior to and after insulating.
- F. Terminations at solenoid valves, 120-volt motors, and other devices furnished with pigtail leads shall be made using self-insulating forked compression connectors and terminal strips within a termination/junction box.
- G. Provide tool-crimp N connectors at coaxial cable terminations except trunk runs.
- H. Provide tool-crimp TRN connectors at twin-axial cable terminations.
- I. Conductor and cable markers shall be provided at splice points.
- J. Fiber Optic Connectors: Active and spare fiber optic cables fibers shall be provided with a breakout kit, and terminated with ST type terminations. ST connectors shall feature:
 - 1. Bayonet Style latch
 - 2. Keyed insertion
 - 3. Spring loading for positive contact

3.6 TESTING

- A. GENERAL:
 - 1. The Contractor shall test conductors and cable in accordance with Section 26 08 00. Instrument and Data Cables shall be subjected to additional tests as specified in this section.
- B. INSTRUMENT CABLE:

1. Each signal pair or triad shall be tested for electrical continuity. Any pair or triad exhibiting a loop resistance of less than or equal to 50 ohms shall be deemed satisfactory without further test. For pairs with greater than 50-ohm loop resistance, the Contractor shall calculate the expected loop resistance considering loop length and intrinsic safety barriers if present. Loop resistance shall not exceed the calculated value by more than 5 percent.
2. Each shield drain conductor shall be tested for continuity. Shield drain conductor resistance shall not exceed the loop resistance of the pair or triad.
3. Each conductor (signal and shield drain) shall be tested for insulation resistance with all other conductors in the cable grounded.
4. Instruments used for continuity measurements shall have a resolution of 0.1 ohms and an accuracy of better than 0.1 percent of reading plus 0.3 ohms. A 500-volt megohmmeter shall be used for insulation resistance measurements.

C. FIBER OPTIC DATA CABLE:

1. Test all data cables, including fiber-optic, with time-domain reflectometer prior to installation.
2. Test all data cables, including fiber-optic, with time-domain reflectometer and transmission impairment analyzer after installation.
3. Test fiber-optic system PMD to FDDI requirements for the following:
4. Transmit power levels
5. AC extinction ratio
6. Optical wave shape
7. Duty cycle distortion
8. Data dependent jitter
9. Random jitter
10. Transmit frequency
11. Minimum optical input
12. Receiver jitter tolerance

D. FIBER OPTIC TESTING: The Owner shall be notified a minimum of 5 days prior to tests and reserve the right to witness field tests.

E. TEST EQUIPMENT:

1. Test equipment shall be traceable to NIST standards. Use the following to perform the pre-installation and post-installation cable tests:
2. Optical time domain reflectometer (OTDR) shall be laser precision, ALT, Inc. Model 5200 LRFL or approved equal.

F. PRE-INSTALLATION TESTS:

1. Perform acceptance tests on the cable prior to installation to verify that the cable conforms to the manufacturer's specifications, and is free of defects, breaks and damages by transportation and manufacturing processes. Perform tests on all reels of cable. Cable shall not be installed until the Owner has reviewed the test report.
2. Verify continuity and attenuation or loss for each fiber on each reel and document results of physical inspections to identify any cable and reel damage conditions, and any deviations from the manufacturer's specifications.
3. Notify the Owner 5 days prior to tests. Document test results and submit the report to the Owner for review. Documentation shall consist of both hard copy and electronic disk complete with application software.

G. POST-INSTALLATION TESTS:

1. OTDR: Conduct the following tests on each cable segment with an OTDR each optical fiber in the fiber cable. Tests shall be conducted at both 1310 and 1550 nm. No splice loss shall have a loss of 0.15 dB or greater with fiber attenuation measured in dB/km.
2. Excess Fiber Coefficient (EFC) Test shall be made as part of the cable testing. The following procedure shall be performed from both ends on each fiber provided.
 - a. Prior to stripping the cable for splicing, record the meter marks to determine the physical cable length.
 - b. Record the fiber Index of Refraction (IOR) from the cable data submitted by the Manufacturer.
 - c. With the OTDR, set to the proper IOR and record the OTDR fiber length.
 - d. Calculate the excess fiber coefficient (EFC) according to the following formula:
$$\text{EFC} = \text{OTDR length} / \text{Sheath length}.$$

H. OLTS FIBER ATTENUATION:

1. Measure the attenuation of each optical fiber in both directions using an Optical Loss Test Set (OLTS) at both 1310 nm and 1550 nm. Test shall be conducted per TIA/EIA 526-7. Provide a reference power level measured with a patch cord and connectors of the same types used on the fiber cable. Measure and record the reference power level of the Laser Light Source. Measure and record the received power level of each optical. Repeat the same measurements in the other direction.
2. The measured insertion loss shall be no greater than the loss calculated in the formula below:

$$IL = 2(Ls) + 2(Lc) + (La)(Length) + 0.5$$

where:

IL	=	Insertion Loss
Ls	=	Splice losses at the pigtails (maximum 0.15 dB)
Lc	=	Connector face loss (maximum 0.6 dB)
La	=	Manufacturer's cable attenuation (dB/km)
Length	=	Fiber length (km)

I. CABLE ACCEPTANCE:

1. Pigtail splices shall have a loss no greater than 0.15 dB, as determined by either a Profile Alignment System (PAS) or Light Injection (LID) splice loss estimate, at the time the splice is made. Splices with an optical loss of greater than 0.15 dB shall be redone.
2. OTDR traces at both 1310 nm and 1550 nm wavelengths display no unexplained losses, reflectance events, or other discontinuities.
3. The insertion losses measured at both 1310 nm and 1550 nm wavelengths and in both directions do not exceed the maximum allowed values. After cable tests, the cable installation shall be subject to a physical inspection to verify the remaining fiber optic specification requirements have been met. If any test requirements are not met, or in the event of fiber test failure of one or more fibers, splice or replace cable as necessary until tests pass.

J. FIBER OPTIC SYSTEM ACCEPTANCE:

1. Perform the inspection and establish a punch-list of the following:
 - a. Fiber splices: neatly organized.

- b. Connectors: capped and undamaged.
 - c. Cabling: organized with no excessive bending.
 - d. Specified coiled cable present in the splice cabinet.
 - e. Cable entrances to the cabinets secured.
 - f. Unused cable delivered to the Owner.
2. Identify cables with the directories installed in each fiber cabinet. Discrepancies found during the inspection of the fiber system installation shall be listed and provided on the punch-list. Inform the Owner upon resolution and completion of the punch-list items

3.7 CABLE SPECIFICATIONS

A. GENERAL: Conductor, wire, and cable types for different locations, service conditions and raceway systems are specified on individual cable specification sheets. Scheduled and unscheduled conductors, wires, and cables shall be installed in accordance with the CABLESPEC SHEETS.

B. CABLE SPEC SHEETS: The following CABLE SPEC sheets are included in this section:

CABLE SPEC	Volts	Product	Purpose
TC	600	Multi-conductor armored power and control cable	Power and control conductors for use in cable trays and hazardous areas.
XHHW	600	Single conductor cross- linked polyethylene power and control cable	Power and control conductors for use in conduit raceways.
VFD2	600	Shielded motor cable for VFD drives	Feeding motors fed from VFD drive for use in Conduit raceways and Cable Tray.
VFD3	600	Shielded motor cable for VFD drives for large HP motors	Feeding motors fed from VFD drive for use in Conduit raceways and Cable Tray.
CORD	600	Rubber Jacketed multi-conductor cable.	Temporary power cable.
INS	600	Single Pair/Triad #18 ST plus overall shield,	Instrumentation
INS/M	600	Multiple Pair/Triad #18STP plus overall shield,	Instrumentation
NC2	300	Category 6 Ethernet cable, 4 pairs, non-armored	Gigabit Ethernet cable
NC3	300	Category 6 Ethernet cable, 4	Gigabit Ethernet cable

FOT-MM	--	pairs, Shielded	
IT	300	Fiber optic cable – multi- mode 350 MHz Enhanced Cat 6	Data Network Gigabit Ethernet, LAN cable.

CABLE SPECIFICATION SHEETS (CABLESPECs) begin on next sheet:

Cable System Identification: TC

Description:	Multiconductor Power Cable and Multiconductor Control Cable:14 AWG and larger stranded conductors; Cable tray rated.
Power Cable:	Insulated green grounding conductor sized per the NEC.
Ground Conductor Size:	Multiple sets of multiconductor power cable: Oversize the grounding conductor per NEC 250.
Control Cable Type:	ICEA Method 1, E-2, without white neutral conductor or green ground conductor
Control Cable Identification:	Conductors color coded per ICEA and conductors numbered
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded per ASTM B8, coated per ASTM B33
Insulation:	XHHW-2, 90 degree C dry, 75 degree C wet, cross-linked polyethylene in accordance with NEMA WC7, UL 44 and ICEA S-66-524.
Jacket:	Cross-linked Polyethylene (XLP)
Flame Resistance:	IEEE 383
Manufacturer(s):	Okonite, Southwire, General Cable, or approved equal.
Execution:	
Installation:	Install in accordance with this Section.
Testing:	Test in accordance with accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: XHHW

Description:	Single conductor Cross-linked polyethylene power and control cable for sizes No. 14 AWG and larger.
Voltage:	600 volts
Conductor Material:	Bare annealed copper; stranded in accordance with ASTM B8
Insulation:	XHHW-2, 90 degree C dry, 75 degree C wet, cross-linked polyethylene in accordance with ICEA S-95-658/NEMA WC70.
Jacket:	None.
Manufacturer(s):	Okonite, X-Olene; Durasheath XLP; or approved equal
Uses Permitted:	Power, control, lighting, receptacle and appliance circuits
Execution:	
Installation:	Install in accordance with Section 26 05 19.
Testing:	Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: VFD2

Description:	Shielded motor cable for VFD drives.
Voltage:	600V
Conductor	Finely stranded tinned copper Class 5 stranded: 16-8 awg, and Class K stranded: 2, 4 & 6 awg.
Material:	Provide pilot or control conductors integral to VFD cable as described in the circuit schedule, shown on the drawings or as required for individual applications.
Insulation:	90 degree C dry or wet, cross-linked polyethylene XPLE in accordance with NEMA.
Assembly:	Individual conductors cabled together with barrier tape, 100% shielding with foil tape and tinned copper braid (85% coverage) inside specially formulated thermoplastic elastomer (TPE) black jacket.
Jacket:	TPE black jacket UL listed to -25 deg C, UL TC-ER listed
	Minimum bend radius of 7.5x overall cable diameter.
Flame	IEEE 383
Resistance:	
Manufacturer(s):	Olflex VFD 2XL Beldon 295XX SAB Cables – VFD Combo XLPE (includes up to 2 pr of control conductors) or approved equal.
Uses Permitted:	Cable tray, conduit, exposed in normal or Class 1, Div 2 per NEC 336, 392 and 501 environments
Execution:	
Installation:	Install in accordance with this Section. Provide cable seals where required by NEC 501.
Testing:	Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: VFD3

Description: Large HP shielded motor cable for VFD drives.

Voltage: 600V

Conductor Class B finely stranded tinned copper 1 awg through 500 kcmil

Provide pilot or control conductors integral to VFD cable as described in the circuit schedule, shown on the drawings or as required for individual applications.

Material:

Insulation: 90 degree C dry or wet, cross-linked polyethylene XPLE in accordance with NEMA.

Assembly: Individual conductors cabled together with barrier tape, longitudinal copper tape inside specially formulated thermoplastic elastomer (TPE) black jacket.

Jacket: TPE black jacket UL listed to -25 deg C, UL TC-ER listed. Minimum bend radius of 15x overall cable diameter. UL 1277, UL 44 listed.

Flame Resistance: IEEE 383

Manufacturer(s): Olflex VFD 2XL

Beldon 29511

SAB Cables – VFD Combo XLPE (includes up to 2 pr of control conductors)

or approved equal.

Uses Permitted: Cable tray, conduit, exposed in normal or Class 1, Div 2 environment.

Execution:

Installation: Install in accordance with this Section

Provide cable seals where required by NEC 501.

Testing:

Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: CORD

Description: Portable Cord, 3-conductor with ground, extra hard usage, oil, weather and water resistant. 10 AWG and smaller, UL listed, type SOOW; larger than 10 AWG, UL listed type G

Voltage: 600 volts

Conductor Material: Type G - Flexible rope lay stranded per ASTM B189 and B33. Type SOOW – Soft bare annealed copper per ASTM B-3, flexible bunch strand per ASTM B-174.

Insulation: Insulation shall be ethylene propylene (EPR) as per ICEA S-68-516 and rated for continuous operation at 90 degrees C.

Jacket: Black chlorinated polyethylene (CPE) rubber ICEA S-98- 658.

Manufacturer(s): Type SOOW - Houston Wire HW250, Southwire Viper, or approved equal.
Type G – Houston Wire HW258, Southwire Type G, or approved equal,

Execution:

Installation: Install in accordance with Section 26 05 19.

Testing: Test in accordance with Sections 26 05 19 and 26 08 00.

Sizing Cables: Cables shall be sized for loads to be served.

Cable System Identification: INS

Description: Single twisted, shielded pair or triad, 18 AWG, instrumentation cable, rated for wet and dry locations.

Voltage: 600 volts

Conductor Material: Bare annealed copper; stranded in accordance with ASTM B8

Insulation: PVC/Nylon

Shield: 100 percent, 1.35 mil aluminum-Polyester tape with 20 AWG 7-strand tinned copper drain wire

Jacket: 48 mil flame-resistance polyvinylchloride

Flame Resistance: UL 1685, ICEA T-29-520 and IEEE 1202.

Manufacturer(s): Single Pair: BELDEN 1120A, or approved equal. Single Triad: BELDEN 1121A, or approved equal.

Execution:

Installation: Install in accordance with Section 26 05 19.

Testing: Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: INS/M

Description: Multiple twisted, shielded pairs or triads, instrumentation cable, rated for wet and dry locations.

Voltage: 600 volts

Conductor Material: Bare annealed copper; stranded in accordance with ASTM B8

Lay: Length 2.5 inches

Insulation: PVC/Nylon

Shield: 100 percent, 1.35 mil aluminum-Polyester tape with 18 AWG 7-strand tinned copper drain wire

Jacket: 48 mil or 68 mil or 84 mil flame-resistance polyvinylchloride

Flame Resistance: UL 1685 and IEEE 1202.

Manufacturer(s): 2 pair: BELDEN 1048A, or approved equal. 4 pair: BELDEN 1049A, or approved equal. 12 pair: BELDEN 1051A, or approved equal. 4 triad: BELDEN 1093A, or approved equal. 12 triad: BELDEN 1095A, or approved equal.

Execution:

Installation: Install in accordance with Section 26 05 19.

Testing: Test in accordance with this Section and Sections 26 05 00 and 26 08 00.

Cable System Identification: NC2

Description: Paired – DataTwist Enhanced Category 5e, gigabit Ethernet, 100BaseTX, 4 pair cable, non-armored

Voltage: 300V rms

Conductor Material: Tinned copper 24 AWG

Insulation Material: Polyolefin (PO)

Shield: Unshielded

Jacket: Polyvinyl chloride (PVC), 0.220-inch diameter

Flame Resistance: UL 1685

Electrical Characteristics: 350 MHz, 53.2 dB/100 meters

Manufacturer(s): Belden 1752A, Okonite, or approved equal.

Uses Permitted: Conduit. Execution:

Execution:

Application: Data Network Communications – Ethernet.

Installation: Install in accordance with this Section and associated equipment manufacturer's instruction.

Testing: Test in accordance with this Section.

Cable System Identification: NC3

Description: Category 5e, gigabit Ethernet, 4 pair cable, shielded

Voltage: 300V rms

Conductor Material: Solid bare copper 24 AWG

Insulation Material: Polyolefin (PO)

Shield: Shielded, overall Beldfoil 100 percent coverage with stranded drain wire

Jacket: Polyvinyl chloride (PVC), 0.260-inch diameter

Flame Resistance: UL 1666 riser

Electrical Characteristics: 100 MHz, 22.0 dB/100 meters

Manufacturer(s): Belden 1533R, Okonite, or approved equal

Uses Permitted: Conduit.

Execution:

Application: Data Network Communications – Shielded Ethernet.

Installation: Install in accordance with this Section and associated equipment manufacturer's instruction.

Testing: Test in accordance with this Section.

Cable Identification: FOT-MM

Description: Multimode fiber-optic cable; Tight-buffer, Dual Layer, with 6-strand or 12-strand fibers as shown on drawings:

Outdoor/Indoor; Riser Rated; Cable Tray Rated

Loose tube construction. Optical fibers shall not adhere to the inside of the buffer tube.

Fibers and buffer tubes shall be color coded with distinct and recognizable colors in accordance with EIA/TIA-598.

Jacket: Jacket: PVC extruded under high pressure directly over the cable core such as to produce cusped ridges that interlock with the subcables

Color: Black

Mark the exterior sheathing with the manufacturer's name, month and year of manufacture, and sequential meter or foot markings for easily determining the length of the cable at all points along the cable run.

Type: OFNR with industrial cable tray rating and IEEE 383 Chapter 8 flame test rated

Fiber Type: Multimode

Clad Diameter: $125 \pm 0.7 \mu\text{m}$

Coating Diameter: $245 \pm 5 \mu\text{m}$ Core Diameter: $62.5 \mu\text{m}$

Attenuation: $\leq 0.35 \text{ db/km @ } 1310 \text{ nm}$

$\leq 0.25 \text{ db/km @ } 1550 \text{ nm}$

Operating Temperature Range: -50 to +75 Deg C

Maximum Tensile Loading: 670/270 lbs (Installation/Operating)

Minimum Cable Bending Radius: 5.7"/3.8" (Installation/Operating)

Manufacturers: Optical Cable Corporation BX-series or approved equal

- (1) Fiber Optic cable shall be suitable for installation in conduit runs within buildings.
- (2) Fiber Optic cable shall be suitable for installation between buildings in outdoor conduit runs which share vaults with 600-volt cable.
- (3) The contractor shall use zip cord jumper cables between patch/breakout panels and communications equipment.
- (4) Fiber shall be terminated with ST style connectors unless otherwise shown on drawings or required by the submitted equipment manufacturer.
- (5) Fiber Optic cables shall have number of fibers as shown in the documents.

(6) The cable that connects PLC to the Fiber Optic interface shall be Belden 9841 or approved equal.

Execution:

Application: Data communication.

Installation: Install in accordance with this Section and associated equipment manufacturer's instruction.

Testing: Test in accordance with this Section.

Cable System Identification: IT

Description:	DataTuff Enhanced Category 6, gigabit Ethernet, 100BaseTX, 4 bonded pair cable, non-armored
Voltage:	300V rms, or 600V rms
Conductor Material:	Bare copper 23 AWG solid.
Insulation Material:	Fluorinated Ethylene Propylene (FEP)
Shield:	Unshielded for 300V application, Bi-Laminate (Alum+Poly) 100% shielded for 600V application
Jacket:	Fluorinated Ethylene Propylene (FEP), 0.214-inch diameter for 300V application and 0.335-inch diameter for 600V application.
Flame Resistance:	UL 723, NFPA 262 for 300V application, UL 16666 for 600V application
Electrical Characteristics:	250 MHz, 32.8 dB/100 meters
Manufacturer(s):	Belden 7931A – 300V, Belden 7953A – 600V, or approved equal.
Uses Permitted:	Conduit, Tray, In-cabinet
Execution:	Use 600V for MCC, Motor Control cabinets or other applications in close proximity to 480V circuiting or where “noise” could be an issue.
Application:	Data Network Communications – Ethernet.
Installation:	Install in accordance with this Section and associated equipment manufacturer’s instruction.
Testing:	Test in accordance with this Section.

END OF SECTION

SECTION 26 05 26
GROUNDING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. System Requirements.
 - 5. Sizing.
 - 6. Submittals.
 - 7. Products.
 - 8. Execution.

1.2 SCOPE

- A. This section specifies the system for grounding electrical distribution and utilization equipment, including but not limited to cabinets, motor frames, manholes, instrumentation, metal surfaces of process/mechanical equipment that contain energized electrical components, metal structures and buildings, outdoor metal enclosures, fences and gates.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE Std 81.2-1991	Guide to Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems
NETA - ATS	Inter-National Electrical Testing Association Inc. - Acceptance Testing Specifications
NFPA 70	National Electric Code (NEC) Article 250

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SYSTEM REQUIREMENTS

- A. Provide equipment grounding conductors in all electrical raceways. The conductors shall be sized in accordance with the National Electrical Code.
- B. Underground, rebar, and building steel ground connections shall be via exothermic weld or hydraulically die crimped cold weld.
- C. Bond building's rebar and building steel attributes to form a ground mat. Bond all site ground mats via exothermic weld or hydraulically die crimped cold weld.
- D. Provide cable tray grounding and bonding in accordance with these project specifications and the drawings.

1.6 SIZING

- A. SIZING: The minimum size of the Equipment Grounding Conductors installed with the circuit conductors shall be per the National Electrical Code Table 250.122. The circuit grounding conductor size routed with a feeder or branch circuit conductors is as shown on the drawings.

1.7 SUBMITTALS

- A. PROCEDURES: Section 01 33 00.
- B. ACTION SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Marked product literature for ground rods, test wells, and equipment ground plate.
4. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.

- d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
5. Grounding system test data.
6. Maintenance Data: For all equipment and for components to include in maintenance manuals specified in Division 1 General Requirements. In addition to requirements specified in Section 01 77 00 - Project Closeout and 01 78 23 - Operations and Maintenance Data include the following:
- a. Routine maintenance requirements for equipment and components.

PART 2 PRODUCTS

2.1 PROCESS EQUIPMENT GROUNDS

- A. The contractor shall coordinate with the equipment supplier to provide an equipment ground lug and contractor provided ground cable and terminations to bond the equipment to the grounding electrode system. Ground cable shall be sized in accordance with this specification. Provide cables, exothermic welds, hydraulic die crimp connections and equipment bolted connections as necessary.

2.2 GROUND CONDUCTORS

- A. The System Ground Conductor shall be soft-drawn, bare annealed copper, concentric stranded, as specified. The minimum sizes shall be as follows, where American Wire Gage (AWG) conductor sizes are not shown or specified:

15 kV-5 kV transformers	4/0 AWG
480V switchboards	4/0 AWG
480V MCC	4/0 AWG
ATS and MTS	2/0 AWG
Cable tray	2/0 AWG
Lighting & Power panels	2 AWG
Exposed metal cabinets	2 AWG
Electrical & Process equipment	2 AWG
Buildings and enclosure	2 AWG
Fences and gates	2 AWG
Motors 25 HP to 250 HP	2 AWG
Motors 1 HP to 25 HP	6 AWG

2.3 GROUND RODS

- A. Ground rods shall be copper covered steel, 3/4-inch diameter and 10-feet long. Rods shall have threaded type removable caps so that extension rods of same diameter and length may be added where necessary.

2.4 CONNECTORS

- A. COMPRESSION CONNECTORS: Compression connections shall be irreversible, cast copper as manufactured by Thomas and Betts, or approved equal.
- B. BOLTED CONNECTORS: Bolted connectors shall be Burndy, O. Z. Gedney, Thomas and Betts, or approved equal.
- C. EXOTHERMIC WELDED CONNECTORS: Exothermic welding products shall be Erico's Cadweld Plus system with a remotely operated battery powered electronic ignition device and moisture resistant weld metal cup for the required mold, or approved equal.
- D. COLD WELDED CONNECTORS: Hydraulically die crimped cold weld connectors shall be cast copper compression cross grid type as manufactured by Burndy, or approved equal.

2.5 TEST WELLS

- A. CONCRETE BOXES
 - 1. Material: High density reinforced concrete box with non-settling shoulders positioned to maintain grade and facilitate back filling with steel checker plate screw down cover.
 - 2. Product and Manufacturer: Provide box assembly from one of the following:
 - a. Concrete Box: Christy Concrete Products, Inc. Model #B1017 or Approved Equal.
 - b. Steel Cover: Christy Concrete Products, Inc. Model # B1017-51JH labeled "GROUND" or Approved Equal.
- B. EXTERIOR TEST WELL: Provide concrete test well with cover and connect the ground grid extension using a removable connector.

2.6 EQUIPMENT GROUND BARS

- A. Ground bars required in power distribution equipment shall be tin plated copper and sized in accordance with manufacturer's standard.

- B. Copper equipment ground bars shall be Erico Eritech EGB Series or approved equal, sized as required for the installation.
- C. Ground bars shown in electrical rooms or adjacent to electrical equipment shall be tin plated copper and shall be wall mounted at 18 inches above finished floor on isolation standoffs. Unless otherwise specifically sized, the ground bars shall be 30 inches long, 4 inches tall and ¼ inches thick. Bars shall have pre-drilled 7/16” holes for termination of lugged conductors. Ground bars shall be Storm Copper, Alpha Equipment Company isolated ground bar assembly, or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Embedded and buried ground connections shall be made by exothermic or irreversible cold weld connectors. Above grade ground connections shall be made by exothermic weld or by utilizing diamond or hexagon dies and a hand compression tool for wire sizes 2 AWG and smaller and a hydraulic pump and compression head for wire sizes 2/0 AWG and larger. Tools and dies shall be approved for this purpose; dimple compressions are not acceptable. Compression connections shall be prepared in accordance with the manufacturer's instructions. Exposed ground connections to equipment shall be made by bolted clamps unless otherwise specified. No solder shall be used in any part of the ground circuits.
- B. Embedded ground cables and fittings shall be exothermically or cold weld bonded to concrete reinforcing steel. Ground wires shall also be securely attached to concrete reinforcing steel with tie wires and prevented from displacement during concrete placement.
- C. Grounding conductors, which are extended beyond concrete surfaces for equipment connection, shall be extended a sufficient length to reach the final connection point without splicing. Minimum extension shall be 3 feet. Grounding conductors, which project from a concrete surface, shall be located as close as possible to a corner of the equipment pad, protected by non-metallic conduit, or terminated in a flush grounding plate. Exposed grounding conductors shall be supported by noncorrosive metallic hardware at 4-foot intervals or less. Grounding conductors for future equipment shall be terminated using a two-hole copper flush mounted grounding plate.
- D. Ground conductors, except signal conductor shields, entering enclosures shall be bonded together to the enclosure if it is metallic and to metallic raceways within or terminating at the enclosure. Prior to making ground connections or bonds, the metal surface at the point of connection shall be cleaned.

- E. Compression-type lugs shall be used in accordance with manufacturer's recommendations.
- F. Grounding conductor shall not be used as a system neutral. Grounding conductor shall not be used as a system neutral.
- G. Surge arresters shall be directly connected to the ground system using copper conductors, sized as specified.
- H. Metallic sheaths or shields of shielded power cable shall be terminated by a copper grounding strip provided with cable connection for connection to the grounding system. Grounding strip shall be sized to withstand available fault current for specimen to be terminated.
- I. Furnish an equipment grounding conductor in all conduit runs sized in accordance with the NEC.
- J. Grounding system shall be provided in compliance with the NEC.
- K. Metallic sheaths or shields of shielded power cable shall be terminated by a copper grounding strip provided with cable connection for connection to the grounding system.
- L. Bond building service piping systems to ground within three feet of entering the building.

3.2 RACEWAY GROUND

- A. All service, feeder and branch circuit raceways shall contain a green insulated ground conductor sized per applicable NFPA 70 National Electrical Code (NEC) tables:
 - 1. T250.66 - Grounding Electro Conductor for Alternating-Current Systems or
 - 2. T250.122 - Minimum Size Equipment Grounding Conductors for Grounding Raceways and Equipment.
- B. Metallic conduits terminating at concentric knock-outs or reducing washers shall be bonded using insulated grounding bushings. Grounding bushings shall be connected to the grounding system using conductors sized in compliance with NEC.
- C. Provide equipment grounding conductors in all power and control circuit raceways.

3.3 EQUIPMENT AND ENCLOSURE BONDING

- A. Electrical distribution and utilization equipment enclosure ground bus, motor frames, manholes, metal structures and buildings, outdoor metal enclosures, fences and gates shall be bonded to the grounding system with conductor sizes as specified.
- B. Connect the conductor to the metal enclosure using a UL listed connector, where the enclosure does not contain an internal ground bus.
- C. Non-electrical equipment with metallic enclosures that are located outdoor, and without a cover or a shade, shall be connected to the grounding system.

3.4 ISOLATED GROUNDING

- A. An isolated ground system shall be installed where required by an equipment manufacturer. The isolated ground conductor shall have green insulation with a yellow stripe and shall be run in the same raceway as the power and neutral conductors. The isolated ground bus shall be kept isolated from neutral and grounding buses.
- B. Where specifically directed by the Owner and required by an equipment manufacturer, the Contractor shall provide an additional isolated ground conductor from the service or separately derived system to an isolated ground bus bar at each associated distribution point.
- C. The neutral conductor from the ultra-isolation transformers shall be grounded only at the single point ground bus in the automatic transfer switch.

3.5 SERVICE AND SEPARATELY DERIVED SYSTEM BONDING

- A. A neutral bonding jumper shall be installed in only one location for each service or separately derived system. The bonding jumper shall be located at the service source or the first immediate distribution point downstream from the source. The neutral and ground buses shall be kept isolated from each other except where the bonding jumper is installed.

3.6 GROUNDING SYSTEM TESTS

- A. The Contractor shall test the facility grounding system and the building grounding system to determine the ground resistance. The grounding test shall be IEEE Standard 81 using the NETA Fall-of-Potential procedure. A plot of ground resistance readings for each isolated ground rod, ground mat, or ground bus shall be submitted on 8-1/2 x 11-inch size graph paper. Point-to-point resistance measurements are not acceptable.
 - 1. The current reference rod shall be driven at least 100 feet from the ground rod or grid under test or as recommended by IEEE Standard 81. The measurements shall be made at 10-foot intervals beginning 25 feet from the test electrode and ending

75 feet from it, in direct line between the ground rod or center of grid and the current reference electrode.

2. A grounding system that shows greater than 2-ohm resistance for the flat portion of the plotted data shall be considered inadequately grounded.
3. The Contractor shall add additional parallel connected ground rods and/or deeper driven rods until the ground resistance measurements meet the 2-ohm requirement. Additional ground rods will be paid for as extra work where the required numbers exceed that specified when authorized and approved by the Construction Manager.
4. Use of salts, water, or compounds to attain the specified ground resistance is not acceptable.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Reference Standards.
 3. Quality Assurance.
 4. Submittals.
 5. Products.
 6. Execution.

1.2 SCOPE

- A. This Section specifies requirements for design, furnishing and installation of support systems for electrical raceways, cables and enclosures.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI C80.1	Rigid Steel Conduit-Zinc Coated
ANSI C80.3	Electrical Metallic Tubing-Zinc Coated
ASTM A48 REV A	Gray Iron Castings
ASTM F512	Smooth-Wall Polyvinylchloride Conduit and Fittings for Underground Installation

Reference	Title
FEDSPEC WW-C-581E	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated
FEDSPEC W-C-1094A	Conduit and Conduit Fittings, Plastic, Rigid
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA VE1	Cable Tray Systems
NEMA VE 2	Cable Tray Installation Guidelines
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NFPA 70	National Electrical Code (NEC)
NFPA 79	Electrical Standards for Industrial Machinery
UL 1	Flexible Metal Electrical Conduit
UL 6	Rigid Metal Electrical Conduit
UL 360	Liquid Tight Flexible Electrical Conduit
UL 651	Rigid Nonmetal Electrical Conduit
UL 797	Electrical Metallic Tubing

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00.

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.

- d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
4. Supports, seismic bracing, and other electrical system mounting elements are generally not shown on the plan drawings. Hangers, supports, seismic restraints, and other electrical system mounting elements shall be submitted in accordance 01 41 20.

PART 2 PRODUCTS

2.1 RACEWAY SUPPORTS

A. CONDUIT SUPPORTS

1. Framing channel with end caps and straps shall be provided to support groups of conduit. Individual conduit supports shall be one-hole pipe straps used with clamp backs and nesting backs where required. Material as specified herein.
2. Conduit supports for PVC coated rigid steel and PVC conduit systems shall be one-hole PVC coated rigid steel clamps or oversized stainless-steel clamps.

B. CEILING HANGERS: Ceiling hangers shall be adjustable steel rod hangers and fittings. Provide J-Type conduit support for single conduit. Straps or hangers of plumber's perforated tape are not acceptable. Unless otherwise shown, hanger rods shall meet ASTM A193 and be sized as 3/8-inch up to 2-inch conduit and shall be 1/2-inch all-thread rod over 2-inch conduit. Material as specified herein.

C. SUSPENDED RACEWAY SUPPORTS AND RACKS:

1. Suspended raceway supports shall consist of concrete inserts, steel rod hangers, and jamb nuts supporting framing channel or lay-in pipe hangers as required. Framing channel shall be a minimum of 12-gauge. Material as specified herein.
2. Hanger rods shall be a minimum of 1/2-inch diameter all-thread rod and shall meet ASTM A193. Suspended raceway supports and racks shall be braced for seismic forces as specified in Section 01 41 20.

D. MATERIALS: Table A specifies the type of raceway supports required for each location and application.

Table A

Location	Framing Channel and Accessories	Threaded Rod, Hardware, & Fittings
Indoor Dry	Zinc Plated Steel	Zinc Plated Steel
Indoor, Wet	316 Stainless Steel	316 Stainless Steel
Outdoor	316 Stainless Steel	316 Stainless Steel
Submerged	316 Stainless Steel	316 Stainless Steel
Headspace	316 Stainless Steel	316 Stainless Steel
Chemical Corrosive	316 Stainless Steel	316 Stainless Steel
Process Corrosive	316 Stainless Steel	316 Stainless Steel

2.2 EQUIPMENT SUPPORTS

- A. Equipment supports shall be installed where shown on the drawings and as required to support the panels and enclosures being installed.
- B. Equipment support materials shall adhere to Table A above unless specified otherwise on the drawings.
- C. Equipment supports shall be installed per details in the Construction Documents.

2.3 ANCHOR BOLTS

- A. Anchor bolts shall be as specified in Section 05 50 00.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Hangers and supports shall be installed with spacing between support points in compliance with all applicable codes.
- B. The cut ends of support channels shall be smoothed and without burrs left from cutting.

END OF SECTION

SECTION 26 05 33

RACEWAYS, BOXES, AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Reference Standards.
 3. Quality Assurance.
 4. Submittals.
 5. Products.
 6. Installation.
 7. Raceway Specification Sheets.

1.2 SCOPE

- A. This section covers the furnishing and installation of electrical conduits, wireways, pull boxes, electrical vaults, hand holes, and fittings. Raceways shall be provided for lighting, receptacles, power, control, instrumentation, signaling and grounding systems.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI C80.1	Rigid Steel Conduit-Zinc Coated
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FEDSPEC WW-C-581E	Conduit, Metal, Rigid and Intermediate; and Coupling, Elbow, and Nipple, Electrical Conduit; Zinc Coated
FEDSPEC W-C-1094A	Conduit and Conduit Fittings, Plastic, Rigid
NEMA ICS 6	Industrial Control and Systems Enclosures
NEMA TC2	Electrical Plastic Tubing (EPT) and Conduit (EPC 40 and EPC 80)
NEMA TC6	PVC and ABS Plastic Utilities Duct for Underground Installation

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. Listing and Labeling: Provide raceway and boxes that are Listed and Labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authority Having Jurisdiction, and marked for intended use for the location and environment in which they are installed.
- C. Comply with NECA's "National Electrical Installation Standards."
- D. Comply with NFPA 70, as adopted and administered by the Authority Having Jurisdiction.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
- a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.

1.6 DELIVERY, STORAGE AND HANDLING

A. PROCEDURES: Section 01 66 00

PART 2 PRODUCTS

2.1 RACEWAY

- A. General requirements for raceway materials specified in this section are listed in the RACESPECS sheets at the end of this section. The type of raceway to be used for any given area and application shall conform to the requirements of Table A in this section.

2.2 BOXES AND FITTINGS

- A. PULL BOXES AND WIRING GUTTERS: Indoor boxes above grade and in unclassified indoor areas shall be NEMA 12 with hinged doors. Similar enclosures for below grade

and outdoors shall be rated NEMA 4X (Type 316 stainless steel) with hinged doors. Boxes in hazardous classified areas shall be rated for the classification, NEMA 7. Box covers shall be provided with hinged doors with quick release latches and oil resistant gaskets. Box and gutter sizes, metal thickness, and grounding shall comply with the National Electrical Code. Bolt-on junction and pull box covers are not allowed.

B. TERMINAL CABINETS: Terminal cabinets located indoors and in unclassified indoor areas shall be NEMA 12. Cabinets located below grade, outdoors, and in corrosive or damp areas shall be NEMA 4X (Type 316 stainless steel). Cabinets in hazardous classified areas shall be rated for the classification, NEMA 7. Cabinets shall be provided with hinged doors with quick release latches. Adjustable terminal strip mounting accessories shall be provided. Cabinets shall be provided with channel mounted terminal blocks rated 30 amperes, 600-volt AC. Terminals shall be No. 8 minimum strap-screw type, suitable for ring tongue or locking spade terminals. Hoffman type CHQR, or approved equal.

C. PULL/JUNCTION BOXES:

1. Indoor boxes above grade and in unclassified indoor areas shall be NEMA 12 with hinged doors. Similar enclosures for below grade and outdoors shall be rated NEMA 4X (Type 316 stainless steel) with hinged doors. Boxes in hazardous classified areas shall be rated for the classification, NEMA 7. Pull and junction boxes for use in raceway systems with conduits 1-1/4" or larger shall be hinged boxes with 2 screw driver operable or quick release latches. Minimum depth of box shall be 5.3", the minimum size shall be as shown on the drawings or as required for the application or NEC. Hoffman type CH or approved equal. For damp, below grade, outdoor, or corrosive applications provide Hoffman type CHFNFSS or approved equal.

2. For Hazardous areas provide Cast copper free aluminum box with neoprene gasketed screw on cover. Crouse-Hinds GUE, GUB, or approved equal.

D. ELECTRICAL VAULTS:

1. Electrical vaults shall be precast concrete with covers designed for H-20 loading. Dimensions shall be as specified on the standard details. Electrical vaults shall be provided with precast solid concrete slab bottoms with sumps as indicated, and a 3 inch by 2-foot-long copper ground bar. Electrical vaults shall be constructed of 3000 psi reinforced concrete. Manhole covers shall be engraved "ELECTRICAL", "CONTROL" or "SIGNAL" as applicable.

2. Manhole covers shall be hinged and watertight unless otherwise indicated on the drawings. Hinged covers shall be made of aluminum and provided with a locking latch. Covers shall be made for easy opening and latching and be provided with a mechanism that shall hold the cover in the open position at 90 degrees, and

provided with spring-assist openers. Manhole covers shall be bonded to ground bar via flexible copper braid or self-grounding connections.

3. Electrical vaults shall be provided with pulling irons and galvanized cable racks on each wall. Cable racks shall utilize porcelain cable supports. Cable racks shall be installed on spacings of not greater than 36 inches and shall be bolted to permanent wall surfaces with anchors or continuous slot concrete inserts.
4. Electrical vaults shall be per the size indicated in the contract drawings and include a H-20 loading where shown on the drawings. Oldcastle or approved equal.

E. HAND HOLES:

1. Hand holes shall be per the size indicated in the contract drawings and include a H-20 loading where shown on the drawings. Hand holes shall be engraved with "ELECTRICAL", "CONTROL" or "SIGNAL" as applicable.
2. Unused conduits shall be provided with conduit seal caps.

2.3 RACEWAY SUPPORTS

- A. All support systems for electrical systems shall be as specified in Section 26 05 29.

2.4 CONCRETE ENCASED DUCT BANKS

- A. Concrete used for duct banks shall be Class E with red oxide added as specified in the Cast-in-Place Concrete section. Rebar shall be as indicated on the drawings.

2.5 UNDERGROUND MARKING TAPE

- A. Underground marking tape shall be for early warning protection of digging around reinforced concrete duct banks. Tape shall be low density polyethylene plastic, nominally 6 inches wide and 4 mil thickness. The plastic color shall be red. A warning shall be imprinted continuously along the length, with message reading similar to "CAUTION - STOP DIGGING - BURIED ELECTRIC LINE BELOW." Tape shall be Brady "Identoline," Services and Materials "Buried Underground Tape," Somerset (Thomas & Betts) "Protect-A-Line," or approved equal.
- B. Underground marking tape for directly buried cables and conduits shall be 6-inch wide metallic lined tape with red polyethylene film on top and clear polyethylene film on the bottom. The message shall be clearly printed with black over red tape and shall read "CAUTION ELECTRIC LINE BURIED BELOW."

2.6 NAMEPLATES

- A. Nameplates shall be provided for all pull and junction boxes in accordance with the requirements of Section 26 05 00. Nameplate numbering shall be as indicated on the drawings. Where no wording is specified, the Contractor shall provide the functional description of the device on the nameplate or as required by the Engineer and Owner. Any nameplates provided where the wording is not specified shall first be approved by the Engineer and Owner.

2.7 FIRESTOPS

- A. Raceway penetrations through masonry walls shall be mortared to seal penetration's air gaps. Raceways penetrations through other walls shall utilize an approved elastomer product to seal up all air gaps.

PART 3 EXECUTION

3.1 INSTALLATION:

- A. Table A specifies the type of raceway required for each location and application. Unscheduled conduit, (i.e. lighting, convenience outlets, etc.), not shown on the drawings shall be in accordance with Table A below.

Table A

Location	Application/Condition	RACESPEC
Indoor Dry	Exposed	GRS
Indoor Wet	Exposed	PGRS
Outdoor	Exposed	PGRS
Concealed	Power circuits embedded in concrete structure or beneath slab-on-grade	PVC4
Concealed	Instrumentation, communications and data signals encased in concrete, duct bank	PGRS
Underground	Power circuits encased in concrete, duct bank	PVC4
Underground	Power circuits directly buried	PVC4
Underground	Instrumentation, communications and data signals directly buried	PVC4
Nonhazardous	Final connection to equipment and light fixtures	LFS
Hazardous corrosive	Exposed	PGRS

Architecturally finished
areas

Final connection to light fixtures

FLEX

3.2 CONDUIT

A. GENERAL:

1. The number of directional changes of a conduit shall be limited to 270 degrees in any run between pull boxes.
2. Conduit runs shall be limited to a maximum of 400 feet, less 100 feet or fraction thereof, for every 90 degrees of change in direction.
3. Provide pull and junction boxes per code. When shown on drawings, box or manhole sizes shall be considered to be minimum sizes and shall be upsized by the Contractor for ease of pulling wire or if required by NEC.

B. INDOOR AND OUTDOOR CONDUIT SYSTEMS:

1. In general, Contractor shall be responsible for determining conduit routing that conforms to the specified installation requirements:
 - a. Conduits for lighting and outlets: exposed
 - b. Conduits for lighting and outlets: concealed
 - c. Conduits for process equipment: exposed
 - d. Conduit inside structures: exposed
 - e. Conduit concealed inside water chambers slabs and walls: not permitted.
2. Existing conduit installations may be utilized provided the installation meets the following requirements:
 - a. The installation meets the project specifications.
 - b. The raceway meets the minimum National Electrical Code (NEC) requirements.
 - c. The raceway is re-labeled per the project raceway schedules.
3. Conduit installation shall conform to the requirements of the RACESPEC sheets and the following specified installation requirements:
 - a. Exposed conduit: Install parallel or perpendicular to structural members and surfaces. Install conduit horizontally and allow minimum headroom of 7 feet.
 - b. Route two or more exposed conduits in the same general routing parallel with symmetrical bends.
 - c. Maintain minimum spacing between exposed parallel conduit and piping runs in accordance with the following when the runs are greater than 30 feet:

- 1) Between instrumentation and telecommunication: 1 inch
 - 2) Between instrumentation and 125 VDC, 48 VDC, and 24 VDC: 2 inches
 - 3) Between instrumentation and 600 VAC and less power: 6 inches
 - 4) Between instrumentation and 600 VAC and greater power: 12 inches
 - 5) Between telecommunication and 125 VDC, 48 VDC, and 24 VDC: 2 inches
 - 6) Between telecommunication and 600 VAC and less power: 6 inches
 - 7) Between telecommunication and 600 VAC and greater power: 12 inches
 - 8) Between 125 VDC, 48 VDC, and 24 VDC and 600 VAC and less power: 2 inches
 - 9) Between 125 VDC, 48 VDC, and 24 VDC and 600 VAC and greater power: 2 inches
 - 10) Between 600 VAC and less power and 600 VAC and greater power: 2 inches
 - 11) Between process, gas, air and water pipes: 6 inches
- d. Space exposed conduit installed on supports not more than 10 feet apart. Space multiple conduits in parallel and use framing channel.
 - e. Comply with the requirements of Section 26 05 00 and herein, where conduits are suspended from the ceiling.
 - f. Secure conduit rack supports to concrete walls and ceilings with cast-in-place anchors or framing channel concrete inserts.
 - g. Install conduits at least 6 inches from high temperature piping, ducts, and flues with temperatures higher than 90-degree C.
 - h. Install conduits between the reinforcing steel in walls or slabs that have reinforcing in both faces.
 - i. Place conduits under the reinforcement in slabs with only a single layer of reinforcing steel. Separation between conduits, conduits and reinforcement, and conduits and surfaces of concrete shall be maintained in accordance with IBC.
 - j. Route conduit clear of structural openings and indicated future openings.

- k. Provide conduits with flashed and watertight seals routed through roofs or metal walls.
 - l. Grout conduits into openings cut into concrete and masonry structures.
 - m. Cap conduits or plug flush conduits during construction to prevent entrance of dirt, trash, and water. Cap or plug empty conduits designated as “future”, “spare”, or “empty” and include a pulling line accessible at both ends. Use anti-seize compound on cap and plug threads prior to installation.
 - n. Determine concealed conduit stubup locations from the manufacturer’s shop drawings. Terminate concealed conduit for future use in specified equipment.
 - o. Install conduit flush with structural surfaces with galvanized couplings and plugs. Caps and plugs shall match the conduit system.
 - p. Provide concealed portions of conduits for future equipment where the drawings indicate future equipment. Match the existing installation for duplicate equipment.
 - q. Terminate conduits that enter enclosures with fittings that match the NEMA rating of the enclosure.
 - r. Underground metallic or nonmetallic conduit that turn out of concrete, masonry or earth: Install a 90-degree elbow of PVC- coated rigid steel conduit before emergence above ground.
 - s. Provide O-Z Gedney “Type DX” or Crouse-Hinds “Type XD” bonded, weather-tight expansion and deflection fitting for the conduit size where conduit cross structural joints that allows structural movement.
- C. UNDERGROUND CONDUIT SYSTEM: Excavation, backfilling, and concrete work shall conform to respective sections of these specifications. Underground conduit shall conform to the following requirements:
1. Underground conduits shall be reinforced concrete encased under roadways or where otherwise exposed to possible damage or where adequate cover does not exist.
 2. Concrete encased conduit shall have minimum concrete thicknesses of 2 inches between conduits, 1 inch between conduit and reinforcing, and 3 inches between reinforcing and earth, unless shown otherwise in an electrical detail.
 3. Concrete encasement on exposed outdoor conduit risers shall continue to 3 inches above grade, with top crowned and edges chamfered.

4. Underground conduit bend radius shall be not less than 2 feet minimum at vertical risers and shall be not less than 3 feet elsewhere.
5. Where conduit and concrete encasement are terminated underground, the conduit and reinforcing shall both extend at least 2 feet past the concrete. Conduits shall be capped and threads protected. Steel surfaces shall be given two coats of epoxy paint.
6. Underground conduits and conduit banks shall have 2 feet minimum earth cover unless otherwise shown.
7. Underground conduit banks through building walls shall be cast-in-place or installed with concrete into boxouts with water stops on all sides of the boxout. Water-stops shall be as specified in the Cast-in-Place Concrete section. Extend the horizontal reinforcement from the duct bank into the boxout terminating with J-hook bends.
8. Conduits not encased in concrete and passing through walls with one side in contact with earth shall be sealed watertight with special rubber gasketed sleeve and joint assemblies or with sleeves and modular rubber sealing elements.
9. Thoroughly swab conduits and raceways on the inside, immediately upon completion of pouring concrete.
10. After the concrete has set and before backfilling, pull a mandrel through each conduit. The mandrel shall have a diameter equal to the nominal conduit inside diameter minus 1/2 inch and shall not be less than 4 inches long.
11. If the mandrel showed signs of protrusions on the inside of the conduit, the conduit shall be repaired or replaced.
12. Provide manufactured plastic conduit spacers anchored to prevent movement during the concrete pour. Manufacture: Carlon, PW Pipe, Underground Devices, or equal.
13. Backfill duct banks with clean fill compacted to 90-percent in 6-inch lifts after concrete has cured. Refer to Section 03 30 00 for concrete requirements including minimum 7 days of cure time prior to backfill over duct banks.
14. Provide PVC threaded adapter with female threads where PVC conduit is joined to steel conduit. Procedure:
 - a. Before assembly: Double coat steel conduit with Red-Robroy, Green-Permacote, Blue-Ocal or approved equal product.

- b. After assembly: Seal with 65-mil thick, 2-inch-wide mastic sealing tape to 1/2-inch beyond threads. Products: 3M Scotch 2228; Plymouth 02625; or approved equal.
 - c. Cover with 20-mil corrosion protection tape applied in 1/2-lap layers to 2-inch beyond threads. Products: 3M Scotchwrap 51; Plymouth Plywrap 12; or approved equal.
15. Provide PVC conduit with bell ends where duct banks terminate at walls, electrical vaults, or hand holes. Install bell ends flush with finished concrete.
 16. Provide PVC conduit with bell ends where conduit rise below grade into a floor mounted electrical panel, electrical cabinet, MCC, or switchboard.
 17. Separate power conduits from signal conduit within the same duct bank by 12" or greater separation where possible.
 18. Separate high voltage duct banks from low voltage duct banks, where shown.
 19. Provide wireways for transition from underslab conduits rising into wall-mounted panels where the number of conduits exceed the NEC allowable panel space in the bottom of the panel. Provide conduit sleeves or fitting for panel transition. Continuous thread or all-thread is prohibited.
- D. ELECTRICAL VAULTS: Unless otherwise specified, electrical vaults installation shall be as follows:
1. Electrical vaults shall be provided in accordance with the drawings
 2. Electrical vaults shall be set on a minimum of 6 inches of crushed rock on top of undisturbed or compacted earth.
 3. Electrical vaults shall be set plumb, so that water shall drain properly to the sump.
 4. Unless installed within a roadway, manhole pre-cast covers, unless otherwise specified, shall be set at 1 to 2 inches above finish grade with surrounding pavement sloping away from the manhole cover.
 5. All metallic hardware inside electrical vaults shall be grounded by connection to the ground plate. Connections shall be made using bolted connections, bonding jumpers and grounding bushings.
 6. Electrical vaults shall be supplied with a ground rod in accordance with 26 05 26.
 7. Electrical vaults for medium voltage cabling shall require all racked MV cabling in vault to complete a 360 degree wrap around inside of vault before exiting.

E. CONDUIT IN BLOCK WALLS:

1. Install multiple runs of conduit that stub-up into a block wall and connect to recessed electrical panels with adequate space for the conduit. Coordinate the electrical work with the structural work and block installers to provide a chase to install the conduit. Install conduit in the cells that do not contain structural reinforcement. Install conduits in the center of the cell to avoid affecting the structural integrity of the wall.
2. Avoid conduit and electrical boxes installation that blocks the cell from being grouted or that blocks the cell reinforcing bars from being grouted. Avoid conduit in the first cell adjacent to doors, windows, corners and wall intersections and install conduits in the center of the first available cell a minimum of 1'-0" from the edge of these openings.
3. Where solid grouting of masonry walls is specified, install conduit and electrical boxes so as to provide sufficient space for grout to flow pass the boxes and conduit in order to fully fill the space beneath and behind. Where boxes need to be held in place, secure the boxes from the face of the block wall. Do not place items behind or next to electrical boxes to hold in place.
4. Coordinate split-face, slump and scored block installation with the masonry contractor to supply smooth face block at the location of receptacles and switches so that the device covers install flush to the wall. Install translucent weather-proof sealing material under device covers on outdoor or wet area locations.

F. CONDUIT SEAL-OFF FITTINGS:

1. Conduits passing:
 - a. Between Class I, Division 1 area and Class I, Division 2 area; provide sealing fittings located at the boundary in accordance with NEC Article- 500.
 - b. From hazardous or corrosive area into a non-hazardous or non-corrosive area.
 - c. Install the seal-off material in the conduit seal-off fittings after inspection.

G. CONDUIT SEALING MATERIAL: Provide HYDRA-SEAL® Handi-Polyurethane-Foam or approved equal product to seal conduits and inner ducts.

1. Sealing product required features
 - a. Compatible with common cable jacket materials.
 - b. ASTM E-84 flame spread requirements and UL Classified.
 - c. Pre-pressurized, portable, one-component closed-cell foam sealing system.
 - d. Dries tack-free within 15 minutes and cures within 24 hours.

- e. Reacts with applied moisture or with ambient humidity.
- f. Remove over-spray with acetone and remove cured foam mechanically

2. Application Criteria:

- a. Apply in ambient temperatures between 60° to 100° F.
- b. Apply bead onto clean surface.

3.3 ELECTRICAL VAULTS AND HANDHOLES

A. Unless otherwise specified, manhole and hand hole installation shall be as follows:

- 1. Electrical vaults shall be provided in accordance with the drawings.
- 2. Electrical vaults, hand holes, and pull boxes shall be set on a minimum of 6 inches of crushed rock on top of undisturbed or compacted earth.
- 3. Electrical vaults and hand holes shall be set plumb so that water shall drain to the sump.
- 4. Manhole covers shall be hinged and flush with the manhole lid. Manhole lids shall be set at 2 inches above finish grade with surrounding pavement sloping away from the manhole cover.
- 5. Metallic hardware inside electrical vaults and hand holes shall be bonded to the ground plate or ground bus using bolted connections, bonding jumpers and grounding bushings.
- 6. Electrical vaults shall be supplied with a ground rod in accordance with 26 05 26.

3.4 RACEWAY NUMBERING

- A. Each conduit shall be provided with a number tag at each end and in each manhole, hand hole, or pull box.
- B. Within electrical vaults, glue raceway tag to manhole wall next to raceway penetration.

3.5 RACEWAY SCHEDULE

- A. GENERAL: Raceways are scheduled on the drawings.
- B. UNSCHEDULED RACEWAY:
 - 1. With the exception of lighting and receptacle circuits, the type and size of raceway shall be as specified on the drawings or schedules.

2. Unscheduled lighting and receptacle raceways shall be sized by the Contractor in accordance with the NEC. Minimum size shall be 3/4 inch for exposed and 1 inch for embedded raceway.

3.6 RACESPEC SHEETS

A. The following RACESPECS are included in Paragraph 3.7.

1. FLEX
2. GRS
3. LFS
4. PGRS
5. PVC4

3.7 RACEWAY SPECIFICATION SHEETS (RACESPEC)

A. RACEWAY SPECIFICATION SHEETS (RACESPEC) – FLEX

Raceway Identification	FLEX
Description	Flexible Steel Conduit
Application	Final connection to equipment subject to vibration or adjustment.
Compliance	UL 1
Construction	Spirally wound galvanized steel strip with successive convolutions securely interlocked
Minimum size	½ inch
Fittings	Compression type
Other	FLEX shall be provided with an internal ground wire.

B. RACEWAY SPECIFICATION SHEETS (RACESPEC) – GRS

Raceway Identification	GRS
Description	Galvanized Rigid Steel Conduit (GRS).
Application	Final connection to equipment subject to vibration or adjustment.
Compliance	ANSI and UL
Finish	Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces.
Minimum size	Unless otherwise specified, ¾ inch for exposed, 1 inch for embedded, encased, or otherwise inaccessible.
Fittings	
Locknuts, Rings, Hubs	Hot-dip galvanized insulated throat with bonding locknut or ring. The hubs shall utilize a neoprene “O” ring and provide a watertight connection. O-Z Gedney, CHM-XXT, or approved equal.
Unions	Electro-galvanized ferrous alloy type Appleton UNF or UNY, Crouse-Hinds UNF or UNY, or approved equal. Threadless fittings are not acceptable.
Conduit Bodies	40% Oversized conduit bodies (Similar to T&B Form 8): Ferrous alloy type with screw taps for fastening covers to match the conduit system. Gaskets shall be made of neoprene.
Boxes	
Indoor	Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square.
Outdoor	Type FD cast ferrous for all device boxes and for junction boxes less than 6 inches square.
Corrosive	NEMA 4X stainless steel or nonmetallic, as specified.
Hazardous	NEMA Class 7 cast ferrous.
(contd. below)	

Raceway Identification	GRS
Elbows	
¾ " thru 1 ½"	Factory fabricated or field bent
2" thru 6"	Factory fabricated only
Conduit Bodies (Oversized)	
¾ " thru 4"	Malleable iron, hot-dip galvanized, unless otherwise noted. Neoprene gaskets for all access plates. Tapered threads for conduit entrances
5" and 6"	Electro-galvanized iron or cast-iron box
Expansion Fittings	Expansion fittings in embedded runs shall be watertight with an internal bonding jumper. The expansion material shall be neoprene allowing for 3/4-inch movement in any direction
Manufacturers	Appleton, Crouse-Hinds, Hubbell, O. Z. Gedney, or approved equal
Installation	<p>Rigid steel conduit shall be made up tight and with conductive thread compound. Joints shall be made with standard couplings or threaded unions. Steel conduit shall be supported away from the structures using hot-dip galvanized malleable iron straps with nesting backs or framing channel.</p> <p>Conduit entering boxes shall be terminated with a threaded hub with a grounding bushing.</p> <p>Exposed male threads on rigid steel conduit shall be coated with zinc-rich paint.</p>

C. RACEWAY SPECIFICATION SHEETS (RACESPEC) - LFS

Raceway Identification	LFS
Description	Liquidtight Flexible Steel Conduit.
Application	Final connection to equipment subject to vibration or adjustment.
Compliance	UL 360.
Construction	Spirally wound galvanized steel strip with successive convolutions securely interlocked and jacketed with liquidtight plastic cover.
Minimum size	$\frac{3}{4}$ inch, except for instruments where $\frac{1}{2}$ inch is acceptable.
Fittings	<p>Cadmium-plated malleable iron body and gland nut with cast-in lug, brass grounding ferrule threaded to engage conduit spiral</p> <p>O-ring seals around the conduit and box connection and insulated throat</p> <p>Provide forty-five and ninety degree fittings where applicable</p> <p>Provide PVC coated flexible conduit and fittings where the conduit system is PVC coated</p>
Installation	Length of flexible liquidtight conduit shall not exceed 36 inches in length. Use conductive thread compound.

D. RACEWAY SPECIFICATION SHEETS (RACESPEC) – PGRS

Raceway Identification	PGRS
Description	<p>Rigid Steel Conduit, Corrosion-Resistant, Polyvinyl Chloride (PVC) Coated.</p> <p>Provide factory made and coated elbows.</p>
Compliance	ANSI and UL. The PVC coated rigid galvanized steel conduit shall meet NEMA RN1-2005 and UL-6 PVC adhesion performance requirements.
Finish	<p>PGRS shall be hot-dip galvanized rigid steel conduit as specified in 26 05 33-7.03 GRS, with a PVC Coating. The PVC coating shall be gray, minimum 40 mils thick, bonded to the outside and continuous over the entire length of the conduit except at the threads, and be free of blisters, bubbles, or pinholes. Thread protectors shall be used on the exposed threads of the PVC coated conduit</p> <p>A 2-mil coat of urethane enamel coating shall be bonded to the inside. Coating shall be free of pinholes. Bond strength shall exceed the tensile strength of the PVC coat.</p>
Minimum size	$\frac{3}{4}$ inch
Fittings	Similarly coated to the same thickness as the conduit and provided with Type 316 stainless steel hardware. Conduit and fittings shall be manufactured by the same company. Conduit and fittings shall be coated by the same company. Male threads on elbows and nipples, and female threads on fittings or conduit couplings shall be protected by application of urethane coating.
Covers	PVC coated covers shall have a NEMA 4X rating and stainless-steel hardware.
Conduit Bodies	40% Oversized conduit bodies with covers as specified above.
Hubs	<p>Hubs for connection of conduit to junction, device, or terminal boxes shall be threaded cast ferrous alloy.</p> <p>Hubs shall have the same PVC coating as the conduit and insulating grounding bushings. Hubs shall utilize a neoprene “O” ring and shall provide a watertight connection.</p>

Boxes

Nonhazardous Type FD cast ferrous with PVC coating for all device boxes and for junction boxes less than 6 inches square.

Hazardous NEMA Class 4X stainless steel or nonmetallic for junction boxes 6 inches square and larger.

Manufacturers Ocal Blue, Robroy Industries, Plasti-Bond, Perma-Cote, KorKap or approved equal.

Installation Plastic coated conduit shall be made up tight, threaded, and installed using tools approved by the PVC-coated conduit manufacturer.

Exposed conduit threads shall be covered by a plastic overlap coated and sealed per manufacturer's recommendations.

Pipe wrenches and channel locks shall not be used for tightening plastic coated conduits. Damaged areas shall be patched, using manufacturer's recommended material. The area to be patched shall be built up to the full thickness of the coating. Painted fittings are not acceptable.

PVC coated conduit shall be supported away from the structure using PVC coated conduit wall hangers or PVC coated conduit mounting hardware.

Damaged work shall be replaced.

Training Installers shall be trained and certified in the proper installation techniques provided by the PVC-coated conduit system manufacture. Proof of certification shall be provided under paragraph 26 05 33

E. RACEWAY SPECIFICATION SHEETS (RACESPEC) – PVC4

Raceway Identification	PVC4
Description	Rigid Nonmetallic Conduit.
Application	Heavy wall thickness for direct bury, concrete encasement or surface mounting where not subject to physical damage.
Compliance	NEMA TC2, UL 651
Construction	Schedule 40, high-impact, polyvinylchloride (PVC).
Minimum size	$\frac{3}{4}$ inch exposed; 1 inch embedded or encased
Fittings	PVC solvent weld type.
Boxes	
Indoor	NEMA Class 4, nonmetallic
Outdoor and corrosive	NEMA Class 4X stainless steel or nonmetallic for junction boxes 6 inches square and larger.
Manufacturers	NEMA Class 4X, nonmetallic
Installation	<p>PVC conduit entering fiberglass boxes or cabinets shall be secured by threaded bushings on the interior of the box and shall be terminated with a threaded male terminal adapter having a neoprene O ring.</p> <p>Joints shall be made with standard PVC couplings.</p> <p>PVC conduit shall have bell ends where terminated at walls and boxes.</p>

F. RACEWAY SPECIFICATION SHEETS (RACESPEC) - WW

Raceway Identification	WW
Description	Wireway and Auxiliary Gutter: Match the conduit or raceway system specified and shown on the drawings. Minimum: Flanged, oil-tight type with hinged covers
Application	As shown on the drawings.
Compliance	JIC EMP-1
Finish	NEMA-1 and NEMA-12: Hot-dip galvanized after fabrication, inside and outside. Smooth finished surfaces. NEMA 4X: Type 316 Stainless Steel. Smooth finished surfaces.
Sizes as shown	4 in x 4 in, 6 in x 6 in, 8 in x 8 in
Fittings	PVC solvent weld type.
Indoor non-corrosive area	NEMA-1, NEMA-12 or as shown on the drawings.
Outdoor and corrosive area	NEMA-4X or as shown on the drawings.

END OF SECTION

SECTION 26 05 43

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Definitions.
 - 5. Submittals.
 - 6. Coordination.
 - 7. Safety Requirements.
 - 8. Delivery Storage and Handling.
 - 9. Products.
 - 10. Execution.

1.2 SCOPE

- A. This section includes the requirements for trenching, backfilling and installation of underground ducts and ductbanks, and the design, fabrication, delivery and installation of pull boxes, handholes, manholes and vaults. The extent and location of "Underground Ducts and Raceways for Electrical Systems" Work is shown in the Contract Documents.

1.3 REFERENCE STANDARDS

- A. ASTM (American Society for Testing and Materials)
- B. NFPA 70 (National Fire Protection Association) - National Electrical Code
- C. WSDOT/APWA Specifications, Section 6-02.3

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 DEFINITIONS

- A. Duct: Electrical conduit and other raceway, either metallic or nonmetallic, used underground, embedded in earth or concrete.
- B. Ductbank: 2 or more conduits or other raceway installed underground in the same trench or concrete envelope.
- C. Handhole/Pull Box: An underground structure provided with an open or closed bottom, and sized to allow personnel to reach into, but not enter, for the purpose of installing, operating or maintaining equipment or wiring or both.
- D. Manhole: An underground utility structure, large enough for a person to enter, with facilities for installing, operating and maintaining submersible equipment and cables.
- E. Vault: An underground structurally solid utility structure including all sides, top and bottom, where entry is limited to personal qualified to install, maintain, operate or inspect the equipment or cable enclosed. The enclosure may have openings for ventilation, personnel access, cable entrance, and other openings required for operation of equipment in the vault.

1.6 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. Submit materials data in accordance with of Section 01 33 00 - Submittals. Furnish manufacturers' technical literature, standard details, product specifications, and installation instructions for all products.
- C. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
- a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
- D. Submittals shall include the following:
1. Product Data:
 - a. Duct-bank separators and components
 - b. Ducts, and accessories including elbows, end bells, bends, fittings and solvent cement
 - c. Vault, Manholes, Handholes, Pull Boxes and accessories
 - d. Warning tape and planks
 2. Shop drawings:
 - a. Precast or Factory-Fabricated Underground Utility Structures:

- 1) Dimensioned plans, elevations, sections, details, attachments to other work, and accessories.
 - 2) Duct entry provisions, including locations and duct sizes.
 - 3) Reinforcement details.
 - 4) Frame and cover design and manhole frame support rings.
 - 5) Ladder details.
 - 6) Grounding details.
 - 7) Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
- b. Factory-Fabricated Handholes, and Pull Boxes Other than Precast Concrete:
- 1) Dimensioned plans, sections, and elevations, and fabrication and installation details.
 - 2) Duct entry provisions, including locations and duct sizes.
 - 3) Frame and Cover design.
 - 4) Grounding details.
 - 5) Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
 - 6) Details, technical data and design calculations for frames and covers.
3. Quality Assurance and Testing:
- a. Qualification data and test results from tests specified in "Quality Assurance" Article. Provide all information specified.
4. Duct-Bank Coordination Drawings as specified in "Coordination" Article.
5. Certificate for concrete and steel used in underground precast concrete utility structures, according to ASTM C 858.
6. Qualification Data: For Professional Engineer and testing agency responsible for testing nonconcrete handholes and boxes.
7. Inspection report for factory inspections, according to ASTM C 1037.

8. Record Documents: Show dimensioned locations of underground ducts, handholes, and manholes from nearest building or permanent structure.

1.7 COORDINATION

- A. Show duct profiles and coordination with other utilities and underground structures. Include plans and sections, drawn to scale and show bends and locations of expansion fittings. Revise locations and elevations from those indicated as required to suit field conditions and ensure that duct runs drain to manholes and handholes. Coordinate layout and installation of ducts, manholes, and handholes with final arrangement of other utilities as determined by field verification. Contractor shall coordinate all modifications with the Engineer prior to final installation.

1.8 SAFETY REQUIREMENTS

- A. Comply with safety and protection requirements of Section 26 05 00 - Electrical Work – General.
- B. Perform Work in accordance with the safety requirements of the Department of Labor Occupational Safety and Health Administration, Volume 36, Number 75, Part II, Subpart P, “Excavations, Trenching, and Shoring,” and with Section 7 of the Manual of Accident Prevention in Construction as published by the Association General Contractors of America, Inc.
- C. Educate supervisors and employees on safety requirements and practices to be followed during the course of the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.
- B. Store precast concrete units at site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.
- C. Lift and support precast concrete units only at designated lifting or supporting points.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
 1. Precast concrete handholes and pull boxes:
 - a. Utility Vault/Oldcastle Precast Group.

- b. Utility Concrete Products, LLC.
 - c. Concast.
 - d. Or Approved Equal.
2. Fiberglass Handholes and Boxes:
- a. Carson Industries LLC.
 - b. Christy Concrete Products.
 - c. Oldcastle Precast.
 - d. Quazite: Hubbell Power System, Inc.
 - e. Or Approved Equal.
3. Precast Manholes and Vaults:
- a. Utility Vault / Oldcastle Precast Company.
 - b. Shaw PIPE; Division of Shawcor Co.
 - c. American Concrete.
 - d. American Concrete.
 - e. Or Approved Equal.
4. Duct Sealing Compound:
- a. Polywater.
 - b. Filoform.
 - c. Or Approved Equal.

2.2 CONDUIT AND DUCTS

A. Metallic Conduit:

- 1. Galvanized Rigid Steel Conduit (GRC): ANSI C80.1
- 2. PVC-Coated Rigid Steel Conduit: ANSI RN 1. Coating thickness shall be 0.040 inch, minimum.

B. Nonmetallic conduit: Use underground only for medium-voltage and low-voltage applications

- 1. Rigid Plastic Conduit: NEMA TC 2, UL 651A, Schedule 40 and Schedule 80 PVC, rated for use with 90°C conductors under all installation conditions and labeled for underground use.
- 2. Liquid-Tight Flexible Nonmetallic Conduit (LFNC): UL 1660.

C. Conduit Fittings:

1. Steel Fittings: Zinc-coated, cast malleable, ferrous metal, threaded fittings, with neoprene cover gasket on each fitting installed outdoors.
2. PVC Conduit and Tubing Fittings: NEMA TC 3. Provide PVC fittings for PVC conduit and suitable watertight connections where PVC conduit connects to galvanized steel conduit.
3. Seal Bushings: O.Z. compound bushing on each conduit entering a building from outside underground and on each conduit passing from one space into another, which is normally at a lower temperature.
4. Hubs: Appleton "Hub" or "Hub-U" series, Thomas & Betts "370" series, Or Approved Equal hub on each conduit terminating in a box where a hub was not previously provided.
5. Unions: Appleton Type "EC", Thomas & Betts "Erickson Coupling" conduit unions, Or Approved Equal where necessary.

2.3 DUCT SUPPORT/SPACERS

- A. Rigid PVC spacers selected to provide [3 1/2"] minimum duct spacings and concrete cover depths indicated, while supporting ducts during concrete pour. Refer to drawing details for additional duct spacing requirements.

2.4 PRECAST CONCRETE HANDHOLES AND PULL BOXES

- A. Comply with ASTM C 858 for design and manufacturing processes.
- B. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom. Walls and bottom shall be constructed to support rating of cover. Frame and cover shall form top of enclosure.
 1. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
 2. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - a. Type and size shall match fittings to duct or conduit to be terminated.
 - b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
 3. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

4. Drain hole in base, 2-inch minimum diameter.

2.5 HANDHOLES AND PULL BOXES OTHER THAN PRECAST CONCRETE

- A. General Requirements for Handholes and Boxes: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
 1. Color: Gray.
 2. Configuration: Units shall be designed for flush burial and have closed bottom unless otherwise indicated.
 3. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
 4. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.
 5. Drain hole in base, 2-inch minimum diameter.
- B. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with covers made of reinforced concrete or cast iron.
- C. Street Lighting: Reinforced plastic mortar designed and tested to temperatures of -50°F meeting ASTM D635-91 flammability test.

2.6 PRE-CAST MANHOLES AND VAULTS (AASHTO RATED)

- A. Precast Concrete Units: Interlocking, mating sections complete with accessory items, hardware, and features as indicated on Drawings. Shall be capable of supporting designed loads that are expected at the installed location. Walls and floors shall be reinforced to support rated strength of covers. Include concrete knockout panels 1-1/2 to 2 inches thick for future conduit entrances and sleeves for ground rods.
- B. Design structure according to ASTM C 858.
- C. Structural Design Loading: See structural for loading information.
- D. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 1. Type and size shall match fittings to duct or conduit to be terminated.
 2. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

- E. Ground Rod Sleeve: Provide a 3-inch PVC conduit sleeves in manhole floors 2 inches from the wall adjacent to, but not underneath, the duct routed from the facility.
- F. Joint Sealant: Continuous extrusion of asphaltic butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand the maximum hydrostatic pressures at the installation location with the ground water level at grade.
- G. Source Quality Control: Inspect structures according to ASTM C 1037. Units shall be capable of supporting specified loads.
- H. Drainage:
 - 1. Provide two holes for drainage, two-inch minimum diameter, and provide at least two feet of gravel under manhole.

2.7 CAST-IN-PLACE MANHOLES AND VAULTS

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod. Structures shall be reinforced to support designed loads that are expected at the installed location. Manhole walls and floors shall be reinforced to support rated strength of cover.
- B. Structural design loading for H20.
- C. Drainage:
 - 1. Provide two holes for drainage, two-inch minimum diameter, and provide at least two feet of gravel under manhole.

2.8 FRAMES AND COVERS

- A. Handhole and Pull Box Covers:
 - 1. Uncoated gray iron meeting ASTM A48, Class 35B or ductile iron meeting ASTM A536 Class 70-50-05 or 80-55-06.
 - 2. Reinforced concrete or weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
 - a. Frame and Cover shall be capable of supporting designed loads see Structural for loading information.
 - 3. Cover:
 - a. Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

- b. Cover Handle: Recessed.
- c. Cover Hinges: Concealed, with hold-open ratchet assembly.
- d. Cover to include insert of other devices to facilitate lifting.
- e. Cover secured by tamper-resistant locking devices similar to REA or FARGO.
- f. Machine cover-to-frame bearing surfaces.
- g. Cast-in legend "ELECTRICAL", "COMM" or "LIGHTING" as appropriate. Concealed hinges, with hold-open ratchet assembly.
- h. Legend: Molded lettering, as indicated for each service.

B. Manholes and Vaults

1. Frames, Covers and Ring Components: Comply with structural design loading specified for manholes and vaults. See Structural for loading information.
2. Frame and Cover: Reinforced concrete or [uncoated gray iron meeting ASTM A48, Class 35B] or [ductile iron meeting ASTM A536 Class 70-50-05 or 80-55-06] capable of supporting designed loads.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Provide lifting points on manhole covers.
 - c. Cover Legend:
 - 1) Manhole ID welded on to cover.
 - a) For electrical power manholes, identification shall be "ELECTRICAL #" where # is the manhole number.
 - b) For telecom manholes, identification shall be "COMM #" where # is the manhole number.
3. Manhole Ring Components: Precast concrete rings with dimensions and strength matched to those of highway rated roof opening.
 - a. Mortar for Ring and Frame and Cover Joints: Strength to match rated cover.
 - b. Where required, seal joints watertight using preformed plastic or rubber conforming to ASTM C 990. Install sealing material according to the sealant manufacturers' printed instructions.

2.9 ACCESSORIES

- A. Manhole and Vault Lifting Means
 - 1. Pulling Eyes in Walls: Eyebolt with reinforcing bar fastening insert. 2-inch diameter eye, 1-inch by 4-inch bolt. Working load with 6-inch embedment in 4000 psi concrete: 13,000 pounds minimum tension.
 - 2. Pulling and Lifting Irons in Floor: 7/8-inch-diameter, hot-dipped galvanized, bent steel rod, stress relieved after forming, and fastened to reinforced rod. Exposed triangular opening. Ultimate yield strength: 40,000 pounds shear and 60,000 pounds tension.
- B. Bolting Inserts for Cable Stanchions: Threaded precast channel inserts of hot-dipped galvanized or stainless steel; 3'-0" on center; 1/2-inch internal diameter by 2-3/4 inches deep, flared to 1-1/4-inch minimum at base. Tested ultimate pull-out strength: 12,000 pounds minimum.
- C. Expansion Anchors for Installation After Concrete is Cast: Per section 05 05 19 – Post-Installed Concrete Anchors. Zinc-plated carbon steel wedge type with stainless-steel expander clip, 1/2-inch bolt size, 5300-pound rated pull-out strength, and 6800-pound rated shear strength minimum. Cast in-place inserts not allowed unless cast by vault manufacturer.
- D. Cable Rack Assemblies – heavy duty non-metallic 50% glass reinforced nylon or other non-metallic material having equal mechanical strength, thermal resistance, chemical resistance, dielectric strength and physical properties.
 - 1. Cable Stanchions: Nominal 36 inches high by 4 inches wide, with multiple arm mounting holes and recessed bolt mounting holes.
 - 2. Cable Arms: Arranged for secure drop in attachment in horizontal position at any location on cable stanchion, and capable of being locked in position. Arms shall be available in lengths ranging from 3 inches with 450 lb. minimum capacity to 20 inches with 250 lb. minimum capacity. Top of arm shall be nominally 4 inches wide and shall have slots along full length for cable ties.
- E. Cable Support Insulators: High glaze, wet-process porcelain arranged for mounting on cable arms.
- F. Floor Grate: 1" thick PVC or HDPE Grate approximately the size of the floor.
- G. Grounding: Ground per Section 26 05 26 – Grounding System.
 - 1. Ground Rods: Ensure rods are copper bonded 3/4-inch by 10-foot minimum.

2. Ground Rod Knock Out: 3-inch knock out for installation of ground rod.
 3. Ground Rod Sleeves: 3-inch PVC conduit sleeve in manhole floors 2 inches from the wall adjacent to, but not underneath, the ducts routed from the facility.
 4. Ground Wire: Stranded bare copper, #2 AWG minimum.
 5. Ground connections shall be compression type connectors, bolted and clamped type.
- H. Duct Sealing Compound: Non-hardening, re-enterable, safe for human skin contact, not deleterious to cable insulation, workable at temperatures as low as 35°F. Capable of withstanding temperature of 300°F without slump, capable of withstanding minimum 22' of water, and chemically resistant to gasoline, oils, acids and bases. Adheres to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and the common metals.
- I. Mechanical Link Seals: for conduit entering vaults or buildings.

2.10 DUCTBACK CONCRETE

- A. Material: Provide in accordance with Section 03 30 00 - Cast-in-Place Concrete and as follows:
1. Gravel: 3/8" maximum.
 2. Slump: 4" maximum.
 3. Compressive strength: 3,000 psi at 28 days.
 4. Color: Dye ductbank concrete red.
 5. Reinforcing (except when GRC is used): Steel conforming to ASTM A15. Provide #4 rebar top and bottom, 2'-0" lap at splices (4 places minimum) and #4 @ 18" on center around perimeter with 3" minimum cover.

2.11 BACKFILL MATERIAL

- A. Lower Trench Portion (surrounding ductbank): Sandy silt, clay silt, sand clay or other material free of stones and conglomerates larger than 2"
- B. Upper Trench Portion (one foot above ductbank up to grade): On-site backfill material consisting of rock, soil or soil-rock mixture containing no rocks or lumps over 6"
- C. Controlled density fill (CDF)

1. CDF shall be a mixture of Portland cement, fly ash, aggregates, water and admixtures proportioned to provide a non-segregating, self-consolidating and free flowing material which will result in a hardened, dense, non-settling and excavatable fill. CDF shall be batched to provide a flowing, non-segregating mix with a slump between 6" and 8". CDF shall be batched and mixed in accordance with Section 6-02.3 of the WSDOT/APWA Specifications.
 2. CDF shall be used as fill above utilities wherever non-settling backfill is required.
- D. Select Native Fill: Unsaturated excavated earth free of rocks, broken concrete and debris 6" and larger, and compacted in 12" lifts to prevent settlement.
- E. Reinforced Concrete Ductbanks:
1. Below Concrete Encasement: 6" minimum compacted 5/8" minus crushed rock.
 2. Above Concrete Encasement: 3" minimum sand.
 3. Upper Trench:
 - a. Areas Under Pavement: Controlled Density Fill.
 - b. Areas Not Under Pavement: Select Native Fill.
- F. Direct-Burial Conduit
1. Initial Bedding: 3" of sand below conduits.
 2. Secondary Bedding: Unsaturated excavated earth free of rocks, broken concrete and debris 2" and larger, and compacted to 6" minimum above conduits.
 3. Upper Trench:
 - a. Areas Under Pavement: Controlled Density Fill.
 - b. Areas Not Under Pavement: Select Native Fill.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine site to receive ducts and manholes for compliance with installation tolerances and other conditions affecting performance of the underground ducts and manholes. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Existing Utilities: Locate all existing utilities in the area prior to performing any excavation.

- C. Existing manholes and handholes within the construction zones shall be provided with a $\frac{3}{4}$ " steel plate cover to maintain protections of the manhole lids and covers. This includes, but is not limited, to construction areas, staging areas, and haul routes.

3.2 EARTHWORK

- A. Comply with OSHA/WISHA safety standards for trenching, including stable slope and shoring requirements.
- B. Depth: Refer to Drawings for trench depth requirements. Correct points of over-excavation using mechanically-compacted backfill to form a smooth trench bottom. Minimum cover according to NEC or Port Standards whichever is more stringent.
- C. Width: Excavate to minimum width consistent with stability of sides.
- D. Slope: Slope trenches so that conduit and ducts drain toward manholes and handholes and away from buildings and equipment.
- E. Rock Excavation: Where rock pad is used for conduit trench, overexcavate 6" below the ductbanks and refill and compact with selected backfill material of same composition.
- F. Muck Excavation: Where muck or unstable material is encountered, over-excavate and backfill to attain proper grade with coarse sand, gravel, or Controlled Density Fill.
 - 1. Stockpile backfill material in an orderly manner; a sufficient distance from the trench to avoid overloading trench banks.
- G. Bedding: The entire bottom of the excavation is to be firm, stable, and at uniform density.
- H. Excavating for Manholes, Vaults Handholes, and Pullboxes: Provide 12" minimum clearance between outer surfaces of unit and embankment or timber used for shoring.

3.3 CONDUIT AND DUCT INSTALLATION

- A. Refer to Specifications and Drawings for conduit and duct materials. Where not specified otherwise, use metallic conduit above and underground.
- B. Metallic Conduit: Only use as specified in Section 26 05 33 - Raceways and Boxes.
- C. Nonmetallic conduit: Use underground only.
 - 1. Underground in Reinforced, Concrete-Encased Ductbanks: For medium-voltage low-voltage and communication applications. Use Schedule 40 Rigid Plastic Conduit

as standard. Use rigid steel conduit on turns 45° or greater. Use Schedule 80 Rigid Plastic Conduit under roadways and in runway areas.

2. Underground Direct-Burial: For low-voltage applications only. Provide rigid plastic conduit, NEMA TC 2, Schedule 40 PVC (except rigid steel under roadways and either rigid steel or Schedule 80 in runway areas), with NEMA TC3 PVC conduit and tubing fittings.
- D. Use PVC fittings for PVC conduit and suitable water-tight connections where PVC conduit connects to galvanized steel conduit.
 - E. Install conduit and ducts as indicated on Drawings and according to manufacturer's written instructions.
 - F. Slope: For ductbanks and conduits without profiles, pitch ducts a minimum slope of 0.5% to drain toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between 2 manholes to drain in both directions. For ductbanks with profiles, install the ductbank at the elevation as shown on the drawings.
 - G. Curves and Bends: For all conduit systems (medium-voltage, low-voltage and communication) use manufactured galvanized rigid steel elbows for stub-ups at equipment and at building entrances with a minimum radius of 36 inches. Where existing conditions may cause 36 inch sweeps to be exposed, 24 inch sweeps may be used with approval of the Engineer. Use manufactured long sweep bends with a minimum radius of 25 feet both horizontally and vertically at other locations. Do not exceed 20 degrees for field bends.
 - H. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
 - I. Duct Entrances to Manholes and Handholes: Space end bells approximately 10 inches on center for 5-inch ducts and varied proportionately for other duct sizes. Change from regular spacing to end-bell spacing 10 feet from the end bell without reducing duct line slope and without forming a trap in the line. Grout end bells into manhole walls from both sides to provide watertight entrances. Core drill entrances where knockouts do not exist.
 - J. Under Slab: Use PVC conduit with and suitable water-tight connections. Use rigid steel sweeps and specified elsewhere in this section and transition to rigid at least 24" before stubbing up through concrete floors in all areas, exposed or within electrical equipment.

1. Conduits stubbing up inside of electrical equipment and terminating there may use PVC with the approval of the Engineer
- K. Building Entrances: Transition from underground duct to rigid steel conduit 5 feet minimum outside the building wall. Use fittings manufactured for the purpose. Follow appropriate installation instructions below:
1. Concrete-Encased Ducts: Install reinforcing in ductbanks passing through disturbed earth near buildings and other excavations. Provide ductbank support at wall without reducing structural or watertight integrity of building wall.
 2. Direct-Buried, Non-encased Duct Entering Non-waterproofed Walls: Provide a Schedule 40 galvanized-steel pipe sleeve for each duct. Caulk space between the conduit and sleeve with duct-sealing compound on both sides for moisture-tight seal.
 3. Waterproofed Wall and Floor Entrances: Provide a watertight entrance-sealing device with the sealing gland assembly on the inside. Anchor device into masonry construction with one or more integral flanges. Secure membrane waterproofing to the device to make permanently watertight.
- L. Separation Between Direct-Buried, Non-Encased Ducts: Provide 3 inches minimum separation for like services, and 12 inches minimum between power and communication ducts.
- M. Concrete-Encased Nonmetallic Ducts: Support on plastic separators coordinated with duct size and required duct spacing, and install according to the following:
1. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts or at 8 feet maximum, and secure separators to the earth and to ducts to prevent floating during concreting. Do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
 2. Concrete: Do not pour concrete until conduit installation has been approved. Spade concrete carefully during pours to prevent voids under and between conduits and at the exterior surface of the envelope. Do not use power-driven agitating equipment unless specifically designed for duct bank application. Pour each ductbank between manholes or other terminations in one continuous operation. When more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing rod dowels extending 18 inches into the concrete on both sides of the joint near the corners of the envelope.
 3. Reinforcing: Reinforce ductbanks where they cross disturbed earth and where indicated on Drawings.

4. Forms: Use the walls of the trench to form the side walls of the duct bank where the soil is self-supporting and the concrete envelope can be poured without soil inclusions; otherwise, use forms.
 5. Minimum Clearances Between Ducts: 3 inches between ducts and exterior envelope wall, 3 inches between ducts for like services, and 12 inches between power and communication ducts.
 6. Depth: Except as otherwise indicated in the contract drawings, install top of duct bank at least 24 inches below finished grade in non-traffic areas and at least 24 inches below finished grade in vehicular traffic areas.
- N. Stub-Ups: Use rigid steel conduit for stub-ups through concrete to equipment. Install insulated grounding bushings at the conduit terminations. For equipment mounted on outdoor concrete pads, extend steel conduit a minimum of 2 feet beyond the edge of the pad. Couple steel conduits to the ducts with adapters designed for the purpose and then encase the coupling with 3 inches of concrete.
- O. Sealing: Provide temporary closure at all duct terminations in manholes and vaults installed in this Project. Use sealing compound and plugs to withstand a minimum of 15 psi hydrostatic pressure.
- P. Pulling Cord: Install 100-pound- test nylon cord in installed ducts, including spares.
- Q. Warning Tape: Bury warning tape approximately 12 inches above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of ductbank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.4 BACKFILLING

- A. Backfill only after all necessary inspections and tests have been performed.
- B. Remove all debris, rocks, broken concrete, and formwork before backfilling trenches.
- C. Use Controlled Density Fill under pavement areas or wherever non-settling backfill is required.
- D. Deposit backfill in layers with materials described in Article "Backfill Material." Uniformly spread and compact backfill with suitable power tampers to the density of the adjacent soil and in such a manner so as not to disturb the alignment of the conduit. If settlement occurs, refill, compact and smooth off to conform to the surface of the ground.
- E. Restore surface features at areas disturbed by excavation, and reestablish original grades.

1. Replace removed sod as soon as possible after backfilling is completed.
2. Restore all areas disturbed by trenching, storing of dirt, cable laying, and other Work.
3. Restore vegetation and provide necessary topsoil, fertilizer, lime, seed, sod, sprigging, or mulching.
4. Replace disturbed paving.

3.5 VAULT, MANHOLE HANDHOLE AND PULL BOX INSTALLATION

- A. Install as indicated on Drawings according to manufacturer's written instructions and ASTM C 891.
 1. In areas which are subjected to vehicular traffic, install units' plumb and level and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.
 2. In areas which are not subject to vehicular traffic, install so that manhole lid is 2" above surrounding dirt or gravel, and with orientation and depth coordinated with arrangement of connecting ducts to minimize bends and deflections required for proper entrances.
 3. Support units on a level bed of crushed stone or gravel, graded from the 1/2-inch sieve to the No. 4 sieve and compacted to the same density as the adjacent undisturbed earth.
 4. Drainage: Where manholes have drain holes in the bottom, provide two feet minimum of gravel below the drain hole or provide a drain line to the nearest storm drain.
- B. Hardware: Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cable and conductors and as indicated on Drawings. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
 1. Field-Installed Bolting Anchors: Do not drill deeper than 3-7/8 inches for field-installed anchor bolts. Use a minimum of 2 anchors for each cable stanchion.
- C. Train cables neatly around corners and secure to walls or ceiling using cable clamps with expansion anchors.
- D. Field cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut.

Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

- E. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring, encircling and in contact with enclosure, and with top surface secured to top of box cover frame. Bottom of ring shall rest on controlled density fill per Engineer of record.
 - 1. Concrete: 3000 psi, 28-day strength with a troweled finish.
 - 2. Dimensions: Minimum 10 inches wide by 12 inches deep or per Engineer of record.

3.6 GROUNDING

- A. Ground underground ducts and utility structures according to Section 26 05 26 Grounding.
 - 1. Handhole: Install two ground rods through floor in each medium voltage handhole and small manhole with top protruding 4" above floor.
 - 2. Manholes and Vaults: Install four ground rods through floor in each medium voltage manhole with top protruding 4" above floor.
 - 3. Ensure rods are copper 3/4 inch by 10 foot minimum.
 - 4. Provide #4/0 ground wire in medium voltage ductbank.
 - 5. Provide #4/0 bare copper ground wire in manhole, attached to wall, attached at 24 inches on center and mounted minimum 6 inches above floor.
 - 6. Provide #2 stranded copper equipment ground minimum in each raceway in use.

3.7 IDENTIFICATION

- A. Identify raceways, cables and equipment as specified in Section 26 05 53 - Electrical Identification.

3.8 TESTING AND CLEANING

- A. Pull brush through full length of ducts. Use round bristle brush with a diameter 1/2-inch greater than internal diameter of duct. Clean internal surfaces of vaults, manholes and handholes, including sump.
- B. Duct Integrity: Swab out ducts with a mandrel 1/2 inch smaller in diameter than internal diameter of ducts.

- C. Grounding: Test manhole grounding to ensure electrical continuity of bonding and grounding connections. Measure ground resistance at each ground rod and report results. Use an instrument specifically designed for ground-resistance measurements.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Coordination.
 - 6. Products.
 - 7. Execution.

1.2 SCOPE

- A. This section includes identification of electrical materials, equipment, and installations. The extent and location of "Electrical Identification" Work is shown in the Contract Documents.

1.3 REFERENCE STANDARDS

- A. NFPA 70E National Electrical Safety Code
- B. NFPA 70 National Electrical Code
- C. ANSI A13.1.,
- D. ANSI Z535.4
- E. 29 CFR 1910.144
- F. 29 CFR 1910.145.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.

- C. Submittals shall include the following.
 - 1. Product Data for each type of product specified.
 - 2. Schedule of identification nomenclature to be used for identification signs and labels.

1.6 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 LABEL TYPES

- A. Manufacturer's standard products with colors prescribed by ANSI A13.1, NFPA 70, and these Specifications. Only temporary markings that are removable without damaging finish are permitted on equipment.
 - 1. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Install labels and nameplates parallel to equipment lines. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 2. Provide engraved laminated phenolic plastic or melamine label for equipment as noted below. Securely attach engraved labels with blunt end, self-tapping stainless-steel screws with blunt ends. Sheet metal screws are not allowed. Provide white letters on black background for normal power, white letters on red background for emergency power.

- a. Provide 5/8-inch minimum height letters on the following equipment:
 - 1) Panelboards, provide labels and warning signs. Secure nameplates to inside surface of door where panel is recessed in finished locations.
 - 2) Switchboards/distribution centers, motor control centers and power centers, pad mounted transformers
 - 3) Secondary feeder breakers in distribution equipment
 - 4) Automatic and manual transfer switches. Labels shall include both normal and emergency source and load.
 - 5) Special equipment housed in cabinets, on outside door.
 - 6) Terminal junction boxes and data gathering panels
 - 7) Cable trays.
 - 8) UPS equipment
- b. Provide 1/4-inch minimum height letters on the following equipment:
 - 1) Disconnects and starters for motors on fixed appliances and starters in MCCs
 - 2) Motor controllers and VFDs.
 - 3) Enclosed switches and circuit breakers
 - 4) Low voltage transformers
 - 5) Feeder circuit breakers in switchboards, switchgear, and distribution panelboards. Circuit breakers shall be labeled with destination panel name or load.
 - 6) Duplex receptacles (self-adhesive labels indicating panel and circuit number)
 - 7) Local control panels
 - 8) Raceways and junction boxes
 - 9) Instrumentation Labels
- c. Refer to table and descriptions in subparagraphs below for acceptable labeling procedure:

Section	Title	Label Types														
		B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
26 05 26	Grounding			$\frac{5}{8}$		X										
26 05 23	Control/Signal Transmission Media	X	X												X	
26 05 19	600-Volt or Less Wire and Cable	X	X			X									X	
26 05 13	Medium-Voltage Cables						X								X	
26 05 33	Raceways and Boxes															X
26 05 43	Underground Ducts and Manholes						X		X	X	X	X			X	
26 27 16	Cabinets and Enclosures			$\frac{3}{8}$												
26 05 36	Cable Trays			$\frac{3}{8}$							X	X				
26 27 26	Wiring Devices				$\frac{1}{4}$											
no section	Electrical Power Monitoring and Control			$\frac{3}{8}$												
26 32 29	Rotary 400 HZ Converters			$\frac{1}{2}$							X					
26 32 13	Engine Generators			$\frac{5}{8}$							X					
26 33 53	Static Uninterruptible Power Supplies			$\frac{5}{8}$							X					
26 29 23	Variable Frequency Controllers			$\frac{5}{8}$							X					
26 12 00	Medium-Voltage Transformers			$\frac{5}{8}$							X		X			
26 35 33	Low-Voltage Power Factor Correction Capacitors			$\frac{3}{8}$	X								X			
26 13 00	Medium-Voltage Load Interrupter Switchgear			$\frac{5}{8}$							X		X			
26 13 26	Medium-Voltage Metal-Clad Drawout Circuit Breaker Switchgear			$\frac{5}{8}$							X		X			
26 18 39	Medium-Voltage Motor Controllers			$\frac{5}{8}$							X		X			
26 13 19	Medium-Voltage Pad-Mounted Vacuum Interrupter Switchgear			$\frac{5}{8}$							X		X			
26 11 16	Secondary Unit Substations			$\frac{5}{8}$												
26 28 16	Enclosed Switches and Circuit Breakers			$\frac{5}{8}$												
26 36 00	Transfer Switches			$\frac{5}{8}$												
26 23 00	Low-Voltage Switchgear			$\frac{5}{8}$												
26 24 13	Low-Voltage Switchboards			$\frac{5}{8}$												
26 09 26	Panelboards			$\frac{1}{2}$												
26 24 19	Motor-Control Centers			$\frac{5}{8}$												
26 29 13	Motor Controllers			$\frac{3}{8}$												
26 25 00	Low-Voltage Busway			$\frac{3}{8}$								X	X			

Section	Title	Label Types																	
26 22 00	Dry-Type Transformers (600-Volt and Less)			½															
26 28 13	Fuses				X														
26 43 13	Transient Voltage Suppression			¾															
26 51 00	Interior Lighting				X														
26 56 00	Exterior Lighting																		
26 09 23	Lighting Controls			½															
28 31 00	Fire Alarm			½															
26 08 00	Acceptance Testing																	X	

- B. Heat-shrink preprinted tubes, flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200-degree F. Comply with UL 224.
- C. Preprinted, flexible, self-adhesive vinyl label laminated with a clear weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Engraved melamine plastic laminate flat stock, 1/16-inch minimum thickness for sizes up to 15 square inches. Use 1/8-inch minimum for sizes larger than 15 square inches. Black with white letters for normal power systems and red with white letters for emergency power systems, with height as shown in table above unless specified otherwise. UV-inhibited when used outdoors. Secure with stainless steel drive screws, stainless steel self-tapping screws or stainless-steel oval-head 6-32 screws tapped into enclosure, or with stainless steel bolts with elastic stopnut.
- E. Adhesive-backed plastic machine-printed labels, white with black letters. Indicate panel name and circuit number(s).
 - 1. For Raceway at more than 600V, provide black letters on an orange field label with the legend, "HIGH VOLTAGE". Indicate feeder number.
- F. Plain-colored vinyl adhesive tape, 3-mil minimum by 1-inch-wide minimum. Apply 1/2-inch minimum over-wrap through 2-inch minimum length. Refer to Section 26 05 19 – Low-Voltage Conductors, Wires and Cables for color.
- G. Engraved plastic melamine laminate flat stock. 1/16-inch minimum thickness for sizes up to and including 15 square inches, 1/8" thick for larger than 15 square inches. White background with black letters for normal power, red background with white letters for emergency power. Holes at each end for attachment with nylon ty-wraps.
- H. Underground line warning tape with pre-printed warning message identifying type of system. Material shall be pigmented polyolefin, continuous-printed on one side, and

compounded for unlimited life when direct buried. 6-inch minimum width by 4-mils thick. Tensile strength of 1750 psi.

1. Inscriptions for Red-Colored Tapes: ELECTRICAL LINE, HIGH VOLTAGE.
 2. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATION CABLE, OPTICAL FIBER CABLE.
- I. Underground metallic line-warning tape with pre-printed warning message identifying type of system. Material shall be detectable three-layer laminate consisting of printed pigmented polyolefin, a solid aluminum-foil core with a clear protective film that allows inspection of the continuity of the conductive core, and compounded for unlimited life when direct buried. Use when metal-detection of line is required on Medium Voltage Systems. 6-inch minimum width by 4-mils thick.
1. Inscriptions for Red-Colored Tapes: "CAUTION: MEDIUM VOLTAGE ELECTRICAL LINE BELOW".
- J. Warning signs: Baked Enamel on aluminum plate, punched or drilled for fasteners, with colors, legend, and size required for applications. ¼-inch grommets in corners for mounting. Minimum nominal size of 7 by 10 inches with 0.040-inch minimum thickness. OSHA standard wording where approved. Custom wording if required. Secure with non-corrosive fasteners.
1. Where applicable, provide labels for multiple power source warning: "DANGER – ELECTRICAL SHOCK HAZARD – EQUIPMENT HAS MULTIPLE POWER SOURCES"
- K. Warning labels: Self-adhesive, multicolor, flexible pressure-sensitive vinyl conforming to OSHA "Danger" and "Caution" standards. 2½ x 1¾" minimum with black letters on yellow background. Label shall read: "WARNING! DO NOT USE AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL - CABLES ADDED AFTER INITIAL INSTALLATION REQUIRE POS/F & I APPROVAL." See Section 26 05 36 – Cable Trays.
1. Where applicable, provide labels for multiple power source warning: "DANGER – ELECTRICAL SHOCK HAZARD – EQUIPMENT HAS MULTIPLE POWER SOURCES"
- L. Stencils: Machine-punched patterns, nonfading waterproof paint with color and formulation appropriate for material and location. Minimum letter height shall be 1 inch.
- M. Adhesive-backed metal labels manufactured with testing agency logo. Punched or engraved with actual settings and date. Label shall be 1/16-inch minimum thickness for sizes up to 15 square inches. Use 1/8-inch minimum for sizes larger than 20 square inches. Black with white letters for normal power systems and red with white letters for emergency power systems, with height as shown in table above unless specified otherwise.

- N. Stainless-steel machine or hand-stamped wire marker plates with one hole at each end for attachment with non-corrosive fasteners that do 0.010-inch minimum thickness (for outdoor application).
- O. Adhesive machine-printed plastic tape, cut to length, black with white letters unless specified otherwise. 3/8-inch minimum width of tape in unfinished areas only. Provide white lettering on red background when served by an emergency source.

2.2 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Floor Marking: Coordinate with the Port Electric Shop for painting working clearances on the floor in front of the equipment.
- B. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior and interior).

PART 3 EXECUTOION

3.1 INSTALLATION

- A. Fasteners for labels and signs: Self tapping, blunt-ended stainless-steel screws, or stainless-steel machine screws with nuts and flat and lock washers. Sheet metal screws are not acceptable. Self-drilling screws are not allowed.
- B. Install identification labels according to manufacturer's written instructions.
- C. Install labels where indicated and as required by the Authority Having Jurisdiction and the Department of Labor and Industries. Locate for optimum viewing and without interference with the operation and maintenance of equipment.
- D. Verify identity of each item before installing identification products.
- E. Labeling abbreviations not permitted without F&I approval.
- F. Temporary markings allowed only if removable without damage to equipment or enclosure finish.
- G. System Identification Color-Coding Bands for Raceways: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

- 1. 208/120V Blue

2. 480/277V Yellow
 3. Controls Black
- H. Cable Ties: For attaching tags. Use general-purpose type, fungus inert, self-extinguishing, one-piece, self-locking Type 6/6 nylon, except as listed below:
1. Outdoors: UV-stabilized nylon.
 2. In spaces handling environmental air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
- J. Coordinate names, abbreviations, colors, graphics and other designations used for electrical identification with corresponding designations used in the Contract Documents or as required by codes and standards. Use consistent designations throughout the Project. Labeling abbreviations are not allowed.
- K. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish Work.
1. Coordinate installing electrical identifying labels prior to installing acoustical ceilings and similar finishes that conceal such items.
- L. Clean surfaces of dust, loose material, and oily films before applying painted or self-adhesive identification products.
- M. Painted Identification Products:
1. Prime surfaces according to manufacturer's instructions prior to applying painted labels:
 - a. For galvanized metal, use single-component, acrylic vehicle coating formulated for galvanized surfaces.
 - b. For concrete masonry units, use heavy-duty, acrylic-resin block filler.
 - c. For concrete surfaces, use clear, alkali-resistant, alkyd binder-type sealer.
 2. Apply one intermediate and one finish coat of paint.

3.2 IDENTIFICATION SCHEDULE

- A. Panelboard Schedules:

1. Panelboard schedules shall utilize a standard panel schedule in Microsoft Excel format which has provision for totaling all loads and performing demand calculations by load category.
 2. This schedule shall be updated with as-built information upon the completion of the project. The contractor shall post a hard copy of the revised panel schedule in any panel modified and submit an electronic copy of the panel schedule in excel format showing accurate as-built information.
 3. Panelboard schedules shall be type-written and printed with a finalized laminated copy placed interior to the panel. Schedule shall be placed in manufacturer door mounted sleeve or affixed to the inner door with adhesive tape.
- B. Instrumentation Labels: Affix permanent type nameplate or tag on all field-mounted instruments, transmitters, pressure gauges, and control valves with proper identification number and service description.
1. Provide 3"x1" aluminum or stainless-steel tag stamped with the instrument loop number designation and the calibrated range.
- C. Medium Voltage Raceways: Provide 5/8-inch-high stenciled or manufactured letters noting "HIGH VOLTAGE", black letters on yellow background on all exposed feeder conduits where entering or leaving switchboards and along conduit runs at 25 feet on center.
- D. Accessible Raceways, More Than 600 V: Self-adhesive vinyl labels. Install labels at all conduit penetrations and along length of exposed conduit run at 25-foot maximum intervals.
- E. Accessible Raceways within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage.
1. Provide labels on all raceways, junction and pull boxes indicating panel designation and circuit number for all circuits in raceway or box, and conduit destination.
 - a. Conduit Label Example: B2-P4-23G-1/1,3,5, B-2601-9.
 - b. Provide labels at all locations where conduit penetrates walls, floors and ceilings, on both sides of penetration.
 - c. Provide labels at all ends or breaks in conduit runs such as electrical rooms, junction boxes, pull boxes, cabinets, maintenance holes, fire penetrations, etc.
 - d. Provide labels on each conduit entering junction or pull box within 12" of junction or pull box.

- e. Provide labels at 25-foot maximum intervals along conduit runs.
 - f. Provide labels on all junction and pullboxes, including in accessible ceiling spaces and exposed in unfinished areas. Refer to specification sections for identification requirements for systems contained within.
 - g. Install labels parallel to equipment lines.
 - h. Labels in unfinished locations, including in accessible ceiling spaces and exposed unfinished areas shall be machine printed vinyl labels minimum ½ inch high, white with black letters. Labels in finished locations shall be adhesive-backed plastic machine printed labels, minimum 3/8-inch-high, white with black letters.
 - i. Lettering shall be a minimum of ¼" high.
 - j. In finished locations, provide labels on inside of junction or pull box cover.
 - k. Provide red lettering when served by an emergency source.
- F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
- 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for feeder and branch-circuit conductors.
 - a. Provide colored insulation when available, typically for wire sized #8 AWG and smaller.
 - b. Provide minimum 2-inch-wide band of colored plastic tape at all terminations and splices (where allowed). 3M Scotch No. 35, Or Approved Equal Electrical Color Coding Tape.
 - c. Colors for 480/277V 3Ø, 4-wire systems:

1) Phase A (left or top):	Brown.
2) Phase B (center):	Orange.
3) Phase C (right or bottom):	Yellow.
4) Neutral:	Gray.
5) Ground:	Green.
 - d. Colors for 208/120V, 3Ø, 4-wire systems:

1) Phase A (left or top):	Black.
2) Phase B (center):	Red.

- 3) Phase C (right or bottom): Blue.
- 4) Neutral: White.
- 5) Ground: Green.
- 6) Isolated Ground: Green with yellow or orange stripe.

e. 575V, 3 \emptyset , 4-wire systems:

- 1) Phase A (left or top): Brown with purple stripe.
- 2) Phase B (center): Orange with purple stripe.
- 3) Phase C (right or bottom): Yellow with purple stripe.
- 4) Neutral: Gray with purple stripe.
- 5) Ground: Green.

f. Colors for 120/240V, 1 \emptyset , 3-wire systems: (non-standard)

- 1) Phase A: Black.
- 2) Phase B: Red.
- 3) Neutral: White.
- 4) Ground: Green.

g. For 240-delta systems (obsolete) the color of the high leg (approximately 200 volts to ground) shall be red. Label interior of all equipment "CAUTION: HIGH LEG IS OVER 120V TO GROUND. DO NOT USE FOR 120V CIRCUITS".

h. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

2. Provide wire markers on each conductor in panelboards, gutters, pull boxes, outlet and junction boxes and at the load connection. Identify with branch circuit or feeder number for power and lighting circuits.

a. Install conductor labeling in panelboards and enclosures to ensure labels are visible.

G. Power-Circuit Conductor Identification, Medium Voltage: Provide labeling at all accessible locations including each termination or interconnection of wiring, and in vaults, pull and junction boxes, manholes, and handholes. Identify conductors with cloth type, split sleeve or tubing type wire and cable markers.

1. Label each cable with phase designation, operating voltage and circuit number.

2. Color Coding for Phase:

a. 4160Y/2400V AC 3 \emptyset , 4-wire:

- 1) Phase A: Black/Pink.
- 2) Phase B: Red/Pink.
- 3) Phase C: Blue/Pink.
- 4) Neutral: White/Pink.

b. 4160V Delta AC, 3Ø, 4-wire:

- 1) Phase A: Black/Brown.
- 2) Phase B: Red/Brown.
- 3) Phase C: Blue/Brown.

c. 12,470V Delta AC, 3Ø, 4-wire:

- 1) Phase A: Black/Orange.
- 2) Phase B: Red/Orange.
- 3) Phase C: Blue/Orange.

3. Provide write-on tags or nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

H. Install instructional sign including the color code for grounded and ungrounded conductors using adhesive-film-type labels.

I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

1. Provide wire markers on each conductor in wire gutters, pull boxes, outlet and junction boxes and at the equipment connection. Identify with control wire number as indicated on schematics and interconnection diagrams or equipment manufacturer's shop drawings for control wiring.

J. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes with the conductor designation.

K. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

- L. Conductor Identification:
 - 1. Conductors to Be Extended in the Future: Indicate source and circuit numbers.
 - 2. Multiple Power or Lighting Circuits in the Same Enclosure: Identify each conductor with source, voltage, circuit number, and phase. Use color coding for voltage and phase indication of secondary circuit.
 - 3. Multiple Control and Communications Circuits in the Same Enclosure: Identify each conductor by its system and circuit designation. Use a consistent system of tags, color coding, or cable marking tape.
- M. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- N. Workspace Indication: Install floor marking tape or paint to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- O. Warning, Caution, and Instruction Signs:
 - 1. Install warning, caution, and instruction signs where indicated or required to ensure safe operation and maintenance of electrical systems and of items to which they connect. Provide OSHA standard text where approved. Provide text of sufficient clarity and lettering of sufficient size to convey adequate information at each location. Mount permanently in an appropriate location. Comply with ANSI A13.1 standard color and design.
 - 2. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
 - 3. Emergency-Operating Signs: Install engraved laminate signs with white legend on red background with minimum 3/8-inch-high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.
- P. Apply equipment identification labels of engraved plastic laminate on each major unit of equipment, including central or master unit of each system. This includes communication, signal, and alarm systems, unless units are specified with their own self-explanatory identification. Except as otherwise indicated, provide a single line of

text with 1/4-inch-high lettering on 1-inch-high label. Use white lettering on black field. Apply labels parallel to equipment lines.

- Q. Outdoor Equipment: Engraved, laminated acrylic or melamine label, to comply with requirements listed above. Provide panel schedule printed on 8.5x11 paper in Port standard format in each panelboard. Insert folded schedule in schedule holder on inside of panel door. Posted panel schedule shall be updated to reflect all new work in panel. Include project completion date on schedule.
- R. Provide self-adhesive tape labels on all receptacle cover plates. Labels shall be machine printed with black lettering on white or clear background.
 - 1. Indicate source panel name and circuit number.
 - 2. Provide red lettering on white or clear background for devices on emergency circuits.
 - 3. Where receptacle faceplate is dark color, provide white letters on clear background.

END OF SECTION

SECTION 26 05 73

POWER SYSTEM STUDIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products.
 - 6. Execution

1.2 SCOPE

- A. This section specifies the preparation of a Power System Study Report using PowerTools SKM, etap, EasyPower or similar software. The report shall include arc flash analysis, short circuit and coordination studies for all voltage levels of the electrical power system. The “electrical power system” starts at and includes the utility feed. Refer to the single-line diagrams of this Contract for details of the electrical power system at the Site. Provide in the report an evaluation of the electrical power system and the model numbers and settings of the protective devices for the entire system. Arc flash analysis shall include the method and recommendation in determining proper Personal Protective Equipment (PPE) and proper labeling of equipment as specified in this section. Provide equipment arc flash warning labeling.
- B. Arc-flash hazard studies shall include all new and modified equipment in the power distribution system including but not limited to:
 - 1. Utility equipment.
 - 2. Switchgear.
 - 3. Switchboards.
 - 4. Generators.
 - 5. Transformers:
 - a. Including all dry-type transformers.
 - 6. Motor Control Centers.

7. Free standing variable frequency drives and starters.
8. Disconnect Switches.
9. Motors.
10. Panelboards:
 - a. Including all 208, 240, and 480-volt systems.
11. Vendor Control Panels.
12. HVAC Equipment.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 141	Recommended Practice for Electric Power Distribution for Industrial Plants
IEEE 242	Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
NFPA 70E	National Electrical Safety Code
IEEE 1015	Recommended Practice for applying Low Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
IEEE 902	Guide for Maintenance, Operation and Safety of Industrial and Commercial Power Systems
NFPA 70	National Electrical Code
IEEE 1584	IEEE Guide for Performing Arc-Flash Hazard Calculations
ANSI NETA ATS 2021	Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment Systems

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. QUALIFICATIONS:
 - 1. Prepared by the manufacturer of the electrical equipment or by an electrical testing service or an engineering company which is regularly engaged in power system studies.
 - 2. All calculations shall be prepared by or prepared under direct supervision of a Washington State registered Professional Electrical Engineer. See the General Conditions for insurance requirements.
- C. CERTIFICATION: Arc flash report to be stamped and signed by a Washington State registered Professional Electrical Engineer.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements,

with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Qualifications of the entity conducting the short circuit and coordination study.
4. Short Circuit Analysis and recommended breaker and relay setting selections in coordination with Section 26 08 00.
5. Electronic copies of power study software models with associated electronic library files.
6. Submit a draft report to the owner within 21 days after receiving all electrical distribution system submittal data and feeder lengths. Approval of submittals shall be contingent on the results of the Power System Study Report.
7. SCOPE OF EQUIPMENT: Contractor shall provide a short circuit and protective device coordination study and arc flash analysis for phase and ground faults for the entire electrical distribution system. The study and labeling conforms to NFPA 70E and the National Electrical Code.

PART 2 PRODUCTS

2.1 POWER SYSTEM STUDY REPORT

- A. Prepare a Power System Study Report summarizing the short circuit and coordination study, arc flash analysis and conclusions or recommendations which may affect the integrity of the electric power distribution system. The model and report shall reflect the project naming convention.
- B. As a minimum, include the following in the report:
 1. Equipment manufacturer's information used to prepare the study.
 2. Assumptions made during the study.
 3. Short circuit calculations listing short circuit levels at each bus.
 4. Evaluation of the electrical power system and the model numbers and settings of the protective devices associated with the system.
 5. Time-current curves including the instrument transformer ratios, model numbers of the protective relays, and the relay settings associated with each breaker.
 6. Comparison of short circuit duties of each bus to the interrupting capacity of the equipment connected to that bus.

7. Analyze the short circuit, protective device coordination, and arc flash calculations and highlight any equipment that is determined to be underrated or causes an abnormally high incident energy calculation. Propose approaches to reduce the energy levels.
8. Summarize the arc flash study and conclusions or recommendations which may affect the integrity of the electric power distribution system.
9. ONE-LINE DIAGRAMS:
 - a. Location and function of each protective device in the system, such as relays, direct-acting trips, fuses, etc.
 - b. Type designation, current rating, range or adjustment manufacturer's style and catalog transformers.
 - c. Power, voltage ratings, impedance, primary and secondary connections of all transformers.
 - d. Nameplate ratings of all motors and generator with their subtransient reactances.
 - e. Transient reactances of generator and synchronous reactances of generator.
 - f. Sources of short circuit elements such as utility ties, generators, and induction motors.
 - g. All significant circuit elements such as transformers, cables, breakers, fuses, reactors, etc.
 - h. Standby as well as normal switching conditions.
 - i. Calculated 3-phase and single-line-ground fault currents at each bus.
 - j. Calculated X/R ratio at each bus.
 - k. Calculated incident energy level at each bus.
 - l. Hazard Risk Category at each bus.

2.2 SHORT CIRCUIT STUDY

- A. As a minimum, include the following:

1. CALCULATIONS:

- a. Determine the paths and situations where short circuit currents are the greatest. Assume bolted faults and calculate the 3-phase and line-to-ground short circuits of each case.
- b. Calculate the maximum and minimum ground-fault currents.
- c. Model variable frequency drives and Solid-State-Soft Starters and include bypass switches.
- d. Where the calculated available fault current is higher than the device ratings determine if a Series-rated system exists. Where series-rated systems have been identified provide labeling per NEC Article 110.22.
- e. Provide labeling at each service and separately derived system indicating calculated available fault current per NEC Article 110.24.
- f. A copy of the SKM or EasyPower “Device Evaluation Comprehensive Branch Report”. Generate report after an “Equipment Evaluation” analysis has been performed using the following settings:
 - 1) Study Result: Balanced
 - 2) Device Type: Protective Devices
 - 3) Fault Type: Bus
 - 4) Fault Study: Comprehensive

2.3 COORDINATION STUDY

- A. As a minimum, include a 17”x11” drawing which includes protective device coordination analysis (TCC) and associated single line. The TCC shall be shown on a 5-cycle, log-log graph background and include:
 1. Time-current curve for each circuit breaker, protective relay, or fuse showing graphically that the settings will allow protection and selectively within Industry standards. Identify each curve and specify the tap and time dial setting. Any circuit protective device that has programmable characteristics shall be included in the coordination study.
 2. Time-current curves for each device to be positioned for maximum selectivity to minimize system disturbances during fault clearing. Where selectivity cannot be achieved, notify the Engineer and Owner as to the cause.
 3. Time-current curves and points for cable and equipment damage.
 4. Circuit interrupting device operating and interrupting times.
 5. Indicate maximum fault values on the graph.

2.4 ARC FLASH ANALYSIS

A. As a minimum, include the following:

1. CALCULATIONS:

a. For each major part of the electrical power system, determine the following:

- 1) Flash hazard protection boundary.
- 2) Limited approach boundary.
- 3) Restricted approach boundary.
- 4) Prohibited approach boundary.
- 5) Incident energy level.
- 6) PPE hazard/risk category.
- 7) Type of PPE required.

b. Produce arc flash warning labels using the existing SKM or EasyPower model template.

c. A copy of the SKM or EasyPower "Arc Flash_IEEE 1584 Report". Generate report after an "Arc Flash Evaluation" analysis has performed using the following settings:

- 1) Standard: IEEE 1584
- 2) Flash Boundary Calculation Adjustments: Use 1.2 cal/cm²
- 3) ≤ 240 V: Report Calculated Values from Equations
- 4) Units: English
- 5) Distance and Boundary: in

PART 3 EXECUTION

3.1 GENERAL

A. Perform the studies using actual equipment data from the equipment and devices that are provided by the Contractor and the data from the actually installed existing equipment or protective relay devices. The Contractor is responsible to gather all field information for the short circuit and coordination studies. Where the report or study is conducted on equipment that is not installed, the short circuit report and the coordination study shall be completely redone at the Contractor's expense.

3.2 IMPLEMENTING PDCS SETTINGS AND ARC FLASH SIGN INSTALLATION

A. The Contractor shall implement the protective device coordination study settings on new and existing equipment as required in Section 26 08 00, based on the accepted Protective Device Coordination Report specified herein and submit a final amended

report of the Record As-Built electrical equipment protective device settings subsequent to start-up and testing.

- B. The Contractor shall work with the Study Firm for implementing the Arc Flash Hazard sign installation requirements for electrical equipment as specified in NEC Article 110.16 Flash Protection and NFPA 70E.

END OF SECTION

SECTION 26 08 00

COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products.
 - 6. Testing.
 - 7. Functional Checkout.

1.2 SCOPE

- A. This section specifies the acceptance testing of electrical materials, equipment, and systems. Provide all labor, tools, material, power, and other services necessary to provide the specified tests. All testing described in this section shall be coordinated with the requirements of Section 01 75 16.
- B. All testing required herein and the test results shall also be submitted and documented as required under Sections 01 75 16, 26 05 00, and where identified within the specific sections.
- C. Test results for a specific piece of equipment shall also be included in the operation and maintenance manual(s).

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI/NETA ATS- 2021	Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment Systems

- C. APPLICATION: Where testing in accordance with this section and other Division 26 Sections is required or recommended by the above standards are to be completed prior to energization, the required tests, including the retesting after the correction of found defects must be complete, and the submittal of final test reports to the Owner for review shall be completed prior to the energizing of material, equipment, or systems.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. Comply with section 5, General, of the ANSI/NETA ATS – 2021 standard for safety, test equipment requirements.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
1. Proposed testing procedures including proposed test report forms.
 2. Test reports including documentation for all tests performed. Test reports shall be submitted for review prior to the equipment being energized.
 3. Execution plan including schedule.

PART 2 PRODUCTS

2.1 TESTING EQUIPMENT AND INSTRUMENTS

- A. The test equipment, instruments and devices used for testing shall be calibrated to test equipment standards with references traceable to the National Institute of Standards and Technology. The test equipment, instruments and devices shall have current calibration stickers indicating date of calibration, deviation from standard, name of calibration laboratory and technician, and date of next recalibration.

2.2 PRODUCT DATA

- A. The following information shall be provided in accordance with Section 01 33 00 and Section 01 75 16:

1. Test reports: Provide the report required in NETA ATS-2021 paragraph 5.4. Results shall be placed on the forms specified in this Section. Test reports shall also be part of the operation and maintenance manuals.
 - a. The test report shall include the following:
 - 1) Summary of project.
 - 2) Description of equipment tested.
 - 3) Description of tests.
 - 4) Device settings.
 - 5) Test data.
 - b. Test data records shall include the following
 - 1) Equipment Identification.
 - 2) Nameplate data.
 - 3) Date of testing.
 - 4) Expected test value/result.
 - 5) Actual test result.
 - 6) Testing results outside of acceptable limits.
2. Short circuit analysis and protective device curves.
3. Defects: Notify the Owner of any material or workmanship found defective within 24 hours of discovery.

PART 3 EXECUTION

3.1 TESTING

A. GENERAL

1. Ensure that all testing performed is in strict conformance with the electrical acceptance tests specified herein. Contact the Owner 10 days prior to the testing to allow witnessing of all tests.
2. The test measurements shall be recorded on specific forms for the subject test.

3. Testing shall be per ANSI/NETA ATS 2021. Provide testing data sheet for the following:
 - a. Switchboard assemblies.
 - b. Transformers – Small Dry-type, air cooled (600 VAC and below, 30 kVA and larger)
 - c. Cables – Low voltage (600 VAC maximum)
 - d. Circuit breakers – Low voltage (Insulated Case/Molded Case)
 - e. Protective Relays
 - f. Instrument Transformers
 - g. Metering and Monitoring Equipment
 - h. Grounding Systems
 - i. Ground Fault Protection Systems
 - j. Rotating Machinery
 - k. Motor Control
 - l. Variable Speed Drive Systems
 - m. Outdoor Generator Systems
 - n. Uninterruptable Power Systems
 - o. Manual and Automatic Transfer Switches

B. FUNCTIONAL CHECKOUT:

1. Comply with all requirements of 26 05 00 and 01 77 00
2. Functional testing shall be performed in accordance with the requirements of this Section. Prior to functional testing, all protective devices shall be adjusted and made operative. Prior to energizing the equipment, perform a functional checkout of the control circuits. Checkout shall consist of energizing each control circuit and operating each control, alarm or malfunction device and each interlock in turn to verify that the specified action occurs. Submit a description of proposed functional test procedures prior to the performance of functional checkout.

3. Verify that motors are connected to rotate in the correct direction. Verification may be accomplished by momentarily energizing the motor after confirming that neither the motor nor the driven equipment will be damaged by reverse operation.

END OF SECTION

SECTION 26 22 13

LOW VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products.
 - 6. Execution

1.2 SCOPE

- A. This section covers the work necessary to furnish and install low voltage transformers.
- B. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- C. The Contractor shall furnish and install single-phase or three-phase general purpose individually mounted dry-type transformers, self-cooled as specified herein, and as shown on the contract drawings.
- D. System Characteristics
 - 1. 480/277 VAC 3 PHASE 4 WIRE: 120/208 VAC 3 PHASE 4 WIRE
 - 2. 480 VAC 1 PHASE: 120/240 VAC 1 PHASE
 - 3. 120 VAC 1 PHASE: 24 VDC

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

- C. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE	Enclosures for Electrical Equipment (1,000 Volts Maximum)
NFPA 70	National Electrical Code
NFPA 70E	National Electrical Safety Code
UL 50	
UL 67	Underwriters Laboratories
NEMA	TP-1

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment first start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
 4. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.
 5. Transformer Ratings including:
 - a. KVA rating
 - b. Primary & Secondary Voltage
 - c. Taps
 - d. Design Impedance
 - e. Insulation class
 - f. Sound level

1.6 DELIVERY, STORAGE AND HANDLING

A. PROCEDURES: Section 01 66 00

- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 CANDIDATE MANUFACTURES/PRODUCTS

- A. Candidate manufacturers and models are listed below. To conform to specified requirements, the manufacturer's standard product may require modification.
 - 1. Eaton
 - 2. Schneider Electric / Square D
 - 3. GE
 - 4. Approved Equal

2.2 DRY TYPE TRANSFORMERS

- A. General: Provide all power transformer equipment as shown on the drawings in conformance with the following specification. All transformers shall be built in accordance with the latest revised IEEE, ANSI, and NEMA standards. All transformers shall conform to NEMA TP-1 standards.
- B. Temperature Ratings: On all transformers, case temperature shall not exceed 30 degrees Centigrade rise above an ambient temperature of 40 degrees Centigrade. Terminal compartment shall be located to ensure termination of cable leads in temperature levels not to exceed 75 degrees Centigrade. Transformers shall be designed for full load operation at a maximum temperature rise of 115 degrees C.
- C. Size: Voltage and KVA rating shall be as shown on the drawings. Provide continuous overload capability of 15%. Primary voltage windings shall have a BIL rating of 10 kV.
- D. Enclosure: For general application, enclosures shall be drip-proof and rodent-proof. Ventilating openings shall be louvered; screening will not be acceptable. Design shall incorporate a built-in vibration dampening system. Finish shall be ANSI 60. Conform to the limited access requirements where applicable.
- E. Core and Coil Assemblies: Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer

operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.

- F. Taps: Furnish a minimum of four taps, two above and two below rated voltage, each 2-1/2 percent, for ratings above five (5) kVA.
- G. Tests: Provide routine tests as listed and described in ANSI specification No. C57.12.00, latest edition. Sound level tests shall be performed on the complete transformer assembly in accordance with the latest NEMA standards. Transformer 0-75 kVA shall conform to NEMA standards.

PART 3 EXECUTION

3.1 EQUIPMENT BASES

- A. Provide equipment bases for all floor-mounted electrical equipment. Unless otherwise indicated, bases shall be poured-in-place concrete, nominally four inches high, and be one inch larger on all exposed edges than the equipment to be mounted. Bolt equipment to pad. Provide concrete pads and mounting provisions for all exterior equipment as indicated on the drawings or specified in other portions of the specifications.

3.2 SUPPORTS

- A. Provide equipment bases for all floor-mounted electrical equipment. Unless otherwise indicated, bases shall be poured-in-place concrete, nominally four inches high, and be one inch larger on all exposed edges than the equipment to be mounted. Bolt equipment to pad. Provide concrete pads and mounting provisions for all exterior equipment as indicated on the drawings or specified in other portions of the specifications.
- B. Provide Uni-strut or similar supports and backing for wall mounted equipment where structure is suited for such mounting.

3.3 DAMP AND WET LOCATIONS

- A. Unless otherwise specified, all electrical enclosures in damp and wet locations shall be NEMA 4, stainless steel.
- B. All conduit entries into equipment located in damp or wet locations shall be through the bottom or lower sides of enclosures. Top entry of conduits will not be allowed.

3.4 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.5 OPERATION AND MAINTENANCE MANUALS

- A. Comply with Section 01 77 00 - Project Closeout 01 78 23 - Operations and Maintenance Data and Part 1 of this specification.

3.6 TESTING

- A. Service Equipment shall be tested for proper operation and function in accordance with Section 26 08 00.

END OF SECTION

SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Reference Standards.
 3. Quality Assurance.
 4. Submittals.
 5. Products.
 6. Executions

1.2 SCOPE

- A. This section specifies panelboards for lighting and power distribution.
- B. Panelboards shall be labeled for arc-flash conditions in accordance with Section 26 05 73.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE	Enclosures for Electrical Equipment (1,000 Volts Maximum)
NEMA PB 1	Panelboards
NFPA 70	National Electrical Code
UL 50	Cabinets and Boxes
UL 67	Underwriters Laboratories, Electric Panelboards

UL 489	Molded-Case Circuit Breakers and Circuit Breaker Enclosures
UL 1449	Surge Suppression Devices, Third Edition

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

- a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
4. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.
 5. Manufacturer's certification that bus bracing is capable of withstanding the specified short circuit condition.
 6. Applicable contract close-out requirements as specified in Section 01 77 00.
 7. Quantity and rating of circuit breakers provided with each panelboard.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. PROCEDURES: Section 01 66 00
- B. Deliver Panelboards completely assembled and protected from water and damage from shipping.
- C. Store panelboards indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 CANDIDATE MANUFACTURERS/PRODUCTS

- A. Panelboards shall be fully rated with a main circuit breaker and shall be dead front type, bolt-on breaker type, with bus bar construction.

- B. Candidate manufacturers and models are listed below. To conform to specified requirements, the manufacturer's standard product may require modification.
 - 1. Eaton
 - 2. Schneider Electric / Square D
 - 3. GE
 - 4. Approved Equal

2.2 ARRANGEMENT AND CONSTRUCTION

- A. The front of the panel shall have concealed trim clamps and hinges. The locks shall be flush with cylinder tumbler-type with spring loaded door pulls. The fronts shall not be removable with doors in the locked position. All panelboard locks shall be keyed alike.
- B. Gutter space shall be provided on all sides of the breaker assembly to neatly connect and arrange incoming wiring.
- C. Panelboard shall be composed of individually mounted circuit breakers designed to be removable without disturbing other breakers.
- D. Panelboards shall have interior hinged face plates that can swing open while not disturbing the circuit breakers.
- E. Panelboards shall be provided with factory installed breaker lock-out means allowing a padlock to lock the breaker in the "off" position.
- F. Panelboards shall be mounted as shown on the construction documents.
- G. A directory holder with clear plastic plate and metal frame shall be mounted on the inside of the door. A typed panel schedule showing as-built configuration shall be provided by the contractor.
- H. Panelboards shall have lockable Door-in-Door type covers.
- I. Panelboard circuit breakers shall be provided with locking tabs to enable OSHA lockout/tagout.

2.3 BUS

- A. Bus shall be tin-plated copper and shall have current ratings as shown on the panelboard schedules, sized in accordance with UL 67. Ratings shall be determined by temperature rise test. Minimum bus size shall be 100 amperes. Panel fault withstand rating shall be equal to the interrupting rating of the smallest circuit breaker in the panel.

- B. Panelboards shall be provided with a separate ground bus and, where specified, with a full capacity neutral bus.
- C. The neutral bus of power panels shall be mounted on insulated stand-offs.

2.4 CIRCUIT BREAKERS

- A. Circuit breakers shall be molded-case type provided for the current ratings and pole configurations specified on the panelboard schedule. Circuit breakers rated 120/208 volt and 120/240-volt alternating current shall have a minimum interrupting current rating of 10,000 amperes (symmetrical) at 240V AC. Circuit breakers rated 480-volt alternating current shall have a minimum interrupting current rating of 14,000 amperes (symmetrical) at 480V AC or as specified on the panelboard schedule.
- B. Circuit breakers shall be bolt-on type.
- C. Circuit breakers shall be listed in accordance with UL 489 for the service specified.
- D. Load terminals of circuit breakers shall be solderless connectors.

2.5 CLEANING

- A. Clean interiors of equipment to remove construction debris, dirt, shipping materials.
- B. Repaint scratched or marred exterior surfaces to match original finish.

2.6 FINISH

- A. Panelboard cabinet shall be fabricated from hot-dip galvanized steel in accordance with UL 50. Panelboard fronts shall have a gray, baked enamel finish.

2.7 NAMEPLATES

- A. Nameplates shall be provided in accordance with the requirements of Section 26 05 53.

PART 3 EXECUTION

3.1 GENERAL

- A. The Contractor shall type in the circuit description on the circuit directory as shown on the final record drawings or panelboard schedule.
- B. Provide "Circuit Directory and Circuit Identification" in accordance with NEC 408.4A and B. Each circuit shall be of sufficient detail to allow each circuit to be distinguished from other circuits. Circuit identification shall include load location and provide

equipment or instrument Tag Number and Tag Description, where shown on the drawings.

3.2 INSTALLATION

- A. Install per manufacturers recommendations.

3.3 CONNECTIONS

- A. Install equipment grounding conductors for switchgear with ground continuity to main electrical ground bus.
- B. Tighten bus joints, electrical connectors, and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B
 - 1. Mark lugs after torquing with red paint such that paint will be visibly disturbed if lugs are disturbed.
- C. Install required safety labels.

3.4 TESTING

- A. Panelboards shall be tested for proper operation and function in accordance with Section 26 08 00.

END OF SECTION

SECTION 26 24 19

MOTOR-CONTROL CENTERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals
 - 5. Products.
 - 6. Execution

1.2 SCOPE

- A. Motor Control Centers as specified and as shown on the contract drawings shall be furnished and installed by the Contractor.
- B. The drawings are the basis for required programming within the MCC for manual operation of the motor starters. The manufacturer or its designated field service group shall program, test, commission and certify operation of the MCC equipment.

1.3 REFERENCE STANDARDS

- A. The Motor Control Center shall be manufactured and tested according to the latest applicable standards of the following agencies:
 - 1. UL 845 – Motor Control Centers
 - 2. NEMA ICS 18-2001 – Motor Control Centers
 - 3. NEMA ICS 1-2001 – Industrial Control and Systems: General Requirements
 - 4. NEMA ICS 2.3-2008 – Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS:
 - 1. Section 26 05 00 General Requirements for Electrical Work.
 - 2. Section 26 29 24 Active Front End Variable-Frequency Controllers

3. Section 26 43 13 Surge Protective Devices for Low-Voltage Electrical Power Circuits
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 3. Arrangements and dimensions shown on the drawings are provided to show intent. Contractor and equipment supplier are to verify installation requirements and ensure the arrangement of the equipment being submitted will suit the intent of the design and is compatible with the installation requirements.

Where the proposed arrangement differs from the intent shown on the drawings, the contractor is to make note of the variance and offer an explanation for the change.

4. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
- C. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.
- D. Certificate of Compliance for Seismic Design of Nonstructural Components and Systems.
- E. Manufacturer Seismic Qualification: The low voltage motor control center(s) shall meet and be certified to seismic requirements specified in the IBC 2018 International Building Code. Refer to Specification section 01 41 20.

1.6 QUALITY ASSURANCE

- A. Manufacturer: For equipment required for the work of this section, provide products which are the responsibility of one manufacturer.
- B. Manufacturer shall have had produced similar electrical equipment for a minimum of 5 years.
- C. Manufacturer shall be ISO 9001 certified.

1.7 DELIVERY, STORAGE AND HANDLING

- A. PROCEDURES: Section 01 66 00

- B. Handle and store equipment in accordance with manufacturer's Installation and Maintenance Manual. One (1) copy of this document shall be provided with the equipment at the time of shipment.
- C. 'Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products from one of the following:
 - 1. Allen Bradley
 - 2. Approved Equal

2.2 GENERAL REQUIREMENTS

A. STRUCTURES

- 1. The enclosure shall be NEMA Type 1A with gasketed doors. Vertical sections shall be constructed with steel divider sheet assemblies formed or otherwise fabricated to eliminate open framework between adjacent sections or full-length bolted-on side sheet assemblies at the ends of the MCC(s).
- 2. Vertical sections shall be 90" high excluding mounting sills, 20" wide and 20" deep for front mounting of units.
- 3. Vertical structures shall be divided into six (6) 12" space factors and shall accommodate six (6) full size NEMA size 1 or 2 Full Voltage Non-Reversing FVNR combination starters. MCC unit sizes shall be multiples of 1/2 space factor (6"). The vertical structures shall accommodate 6" high density and dual mounted units.
- 4. Back-to-back, front and rear unit mounting, structures shall be 21" deep maximum and shall accommodate 12 full size NEMA size 1 or 2 Full Voltage Non-Reversing FVNR combination starters per section.
- 5. 4" wide wireways shall be installed on 20" wide structures and 8" wide wireways on 24" wide structures. Wireways shall be completely isolated from all power busses. The rear surface of the vertical wireway shall be painted white. A minimum of three (3) formed wire cable supports, extending the full depth of the vertical wireway shall be supplied in each vertical section. A separate hinged door shall cover the vertical wireway.

6. Each standard structure shall be supplied with a 12-inch top and six (6) inch bottom horizontal wireway that are continuous for the entire length of the MCC. The minimum horizontal wireway opening between sections is 40 square inches for the top and 30 square inches for the bottom horizontal wireway. A hinged door shall be supplied to cover the top horizontal wireway.
7. Doors are to be hinged in a manner that allows for the removal of individual doors without the removal of any door above or below. Unit doors shall be hinged on the left and vertical wireway doors on the right for unobstructed access to the units and associated vertical wireway. All doors shall be mounted on removable pin-type hinges and secured with steel quarter-turn, indicating type fasteners.
8. Wireways shall be completely isolated from bus compartments by suitable barriers. Sliding barriers between the horizontal bus and top horizontal wireway are not acceptable.
9. Removable top cover plates shall be provided for conduit entry to the top horizontal wireway and shall provide a minimum of 116 square inches of area for conduit location. Top cover plates shall be fabricated from 13-gauge steel.
10. All MCC structures shall be supplied with 1-1/8" high X 3" wide base channel sills that are continuous for the entire length of the shipping split. The base channel sills shall be fabricated of 7-gauge steel and shall be suitable for grouting the base channel sills in place, welding to leveling plates or securing to the floor with 1/2" anchor bolts. MCC structures shall be supplied with reversible bottom end cover plates to cover the bottom horizontal wireway and ends of the base channel sills. The bottom end cover plates shall be factory installed to cover the ends of the base channel sills to prevent entrance of dirt and rodents into the MCC when installed flush on the floor and shall be removable to expose the ends of the base channel sills if they are to be grouted into the floor.
11. A removable, full length lifting angle shall be provided for each shipping split of each MCC. The lifting angle shall be bolted to each side sheet or divider sheet of the shipping split to evenly distribute the weight of the MCC during lifting.
12. MCC's shall be assembled in such a manner that it is not necessary to have rear accessibility to remove any internal devices or components.

B. BUSSING

1. The main horizontal bus shall be:
 - a. Tin plated copper with current rating as shown on the drawings with a 800 amperes minimum and with a conductivity rating of 100% IACS. The horizontal bus bars shall be fully sized to carry 100% of the rated current the entire length

of the MCC. Horizontal bus bars shall be mounted edge wise and located at the top of the MCC. Tapered horizontal bus is not acceptable.] All power bus shall be braced to withstand a fault current of 65,000 RMS symmetrical amperes.

- b. The entire horizontal bus assembly must be located behind the top horizontal wireway at any amperage. Horizontal bus bars located behind usable unit space are not acceptable.
 - c. The horizontal bus shall be isolated from the top horizontal wireway by a clear, flexible, polycarbonate, barrier allowing visual inspection of the horizontal bus without removing any hardware.
2. The vertical bus:
 - a. Shall be rated 300 amperes. Vertical bus bars shall be fabricated of tin-plated solid copper bars with a conductivity rating of 100% IACS.
 - b. The vertical bus assembly shall be isolated from the unit mounting space by means of a full height steel barrier. Provisions shall be made to close off unused unit stab openings in the vertical bus barrier with removable covers.
 3. All bus ratings are to be based on a maximum temperature rise of 65°C over a 40°C ambient temperature.
 4. Horizontal to vertical bus and horizontal bus splice connections shall be made with two (2) 3/8" grade 5 bolts and conical washers at each connection point. All connecting hardware shall be designed to be tightened from the front of the MCC without applying any tools to the rear of the connection.
 5. The horizontal ground bus shall be rated 300-amp copper.
 6. The neutral bus connection shall be rated 600-amp copper.

C. UNITS

1. Plug-in units shall connect to the vertical bus by means of self-aligning, tin plated copper stab-on connectors provided with spring steel back-up springs to insure positive connection to the vertical bus.
2. When vertical ground bus is specified, plug-in units shall include a ground stab which engages the vertical ground bus before the power stabs engage the vertical bus when the unit is inserted into the structure. When the plug-in unit is withdrawn from the vertical bus, the vertical ground stab shall release after the power stabs.
3. The interior of all MCC units shall be painted white, including unit top and bottom plates or isolation barriers.

4. All plug-in units 12" tall and larger will include two (2) auxiliary handles to aid in installation, removal and transporting plug-in units.
5. All plug-in units will include a racking mechanism to assure full engagement with the stab-on connectors with the vertical bus.
6. Plug-in units shall be provided with interference mechanism type draw-out to prevent complete removal of the plug-in unit from the structure in one motion. The interference mechanism shall also provide clear indication when the plug-in unit has been withdrawn to the "TEST" position.
7. A mechanical interlock shall be supplied on all plug-in units to prevent insertion or removal of a unit from the structure when the unit operator handle is in the ON position. This interlock may not be defeated.
8. Each 12" tall and larger plug-in unit shall be secured in the structure by two (2) readily accessible devices, one of which is tool operated. These devices shall be located at the front of the unit.
9. Plug-in units with NEMA Type B or C wiring shall be supplied with unit terminal block mounted within the unit, adjacent to the vertical wireway. For non-high density units, the terminal blocks shall be mounted on a movable bracket that maintains the terminals inside the unit structure for normal operation and pivots into the vertical wireway exposing the terminals for wiring, test and maintenance.
10. All plug-in units shall include a positive means of grounding the unit to the structure at all times.
11. The MCC unit disconnect operator shall operate in a vertical, up-down, plane. 6" units shall operate in a horizontal motion. All unit disconnects shall remain engaged with the disconnect device at all times, regardless of the unit door position. The operating handles shall be interlocked with the unit door so that the door can neither be opened with the disconnect device in the ON position, nor can the disconnect device be turned ON with the unit door open except by operation of a defeater mechanism. Indication of the disconnect device shall be clearly indicated by the position of the operating handle. When applied with circuit breaker devices, the handle shall also provide clear indication of a circuit breaker trip.
12. When pilot lights, push buttons or sector switches are specified. The devices shall be mounted in a formed metal device panel that is capable of accepting four (4) such devices in any combination. The device panel shall be secured to the unit door for normal operation, or mounted on the plug-in unit as required for unit removal and bench testing.

13. Pilot devices shall be heavy duty, oil tight 30mm devices with a NEMA 4 rating. Indicating lights shall be LED push-to-test type. Pilot device contacts shall be rated at 10A, 600 VAC (NEMA A600). The pilot device bodies shall be fabricated from metal.
14. Unit identification nameplate shall be provided for each unit. Nameplates shall be a black surface with white core. Engraving shall cut through the black surface exposing white lettering of the unit designation. Nameplates shall be 1" tall by 3 1/2" wide. Adhesives or glues are not an acceptable means of mounting unit nameplates.

D. WIRING

1. The wiring shall be NEMA Class 1.
2. All internal wiring shall be labeled using heat shrink type material.

E. COMBINATION MOTOR STARTERS

1. The combination motor starters shall be provided with an Allen Bradley thermal magnetic circuit breaker unless noted otherwise on the drawings.
 - a. Combination Motor Starters shall be rated equal to or greater than the AIC rating of the Motor Control Center.
2. Overload Protection
 - a. The overload protection shall be:
 - 1) Allen Bradley E250 solid state overload relay with Class 10-30 protection multifunctional, electronic full motor protection. Detailed operating, service, and diagnostics data via Ethernet.
3. Control Power
 - a. Each starter unit shall be provided with an encapsulated control power transformer of sufficient size to accommodate the contactor coil burden plus all specified auxiliary devices.

F. FEEDERS

1. Feeder disconnects shall be Allen Bradley thermal-magnetic circuit breaker.

2.3 SMART MOTOR STARTER

- A. Motor starter units shall include a microprocessor based protective and control overload that provides NEMA class 10, 15, 20, 25, or 30, thermal trip characteristics,

phase asymmetry (phase imbalance & phase loss) protection, stalled rotor protection, instantaneous over current (jam) and under current protection and provisions for connecting one thermistor. Upper and lower current limits shall be adjustable for tripping and monitoring.

- B. The device shall provide an option of voltage and power monitoring as well as monitoring of power factor (cos-phi or loss of load) protection. Device shall have internal and external ground fault monitoring capabilities to an exacting 0.3-amp equipment protection. Additionally, the device shall have an option of monitoring three RTD's (PT100 or PT1000) temperature sensors or three NTC thermistor sensors.
- C. All protective functions shall be programmed on the motor starter unit such that communication with the network connected control system is not required for operation in "hand" or "off" modes of operation.
- D. The device shall have the ability to designate its inputs as external fault inputs for hardwiring into upstream or downstream parts of the application. Running status of the connected load shall be determined by monitoring motor current to give a true indication of running status. The device shall provide monitoring of operating hours, downtime hours, number of starts, overload trips and have permissible starting capabilities.
- E. The device shall contain four digital inputs and three relay output points for use in controlling the motor starter. Output relays shall be programmable to either turn off or retain their status in the event of a control voltage loss or network failure.
- F. The device shall also include on board logic elements including up to a total of six 3I/1O truth tables, two 2I/1O truth tables, and one 5I/2O truth table.
- G. The device shall have up to four signal conditioners and four non-volatile elements with adjustable (edge rising with memory, edge falling with memory, inverting and non-inverting) conditions. Additional elements shall include up to four timers with adjustable (with closing delay, closing delay with memory, with off delay, with fleeting closing) conditions and four limit monitors for overshoots and undershoots of any of its analog signals.
- H. The device shall communicate via Ethernet to a central master controller and provide motor current, in percent of the motor full load amps, input and output data, status messages ON, OFF, under and over current warning and trip on a continuous cyclical basis.
- I. The user shall have the ability to remotely monitor and program all programmable parameters, diagnostic data and operating data.

- J. The device shall communicate at a maximum of 100Mbit Ethernet communication speed, and shall be auto baud rate sensing.
- K. In the event of a communication network failure or PLC failure, the device shall operate as a stand-alone device. Upon restoration of the network, the device shall resume communication with the network.

2.4 NETWORK

- A. The Allen Bradley Motor Control Center shall be connected to the control system via the Ethernet switch located in the PLC enclosure.
- B. Allen Bradley VFD's shall be supplied with Ethernet communications.
- C. All programmable devices shall be configured per sheet I3 of the project drawings for interoperability of the MCC with the control system.

2.5 METERING

- A. Multifunction digital-metering monitors shall be, microprocessor-based unit suitable for three or four wire systems. Units shall communicate via:
 - 1. Ethernet module
- B. The meter shall be mounted on the door and shall meter at the Main Lugs
- C. Metering Equipment
 - 1. Provide a multi-function, high accuracy digital power metering instrumentation module equipped with LCD display. The power metering module shall provide simultaneous measurements for current, voltage and power parameters. Power meter shall be equipped with a communications port for Industrial Ethernet connection.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation shall be per the manufacturer's recommendations, written instructions, final shop drawings, and contract documents. Installation shall be coordinated with adjacent work to ensure proper sequence of construction, clearances and support.
- B. The Motor Control Center shall not be placed in hazardous locations. The location shall be well ventilated and free from humidity, dust, and dirt. The temperature shall be no less than 32°F and no greater than 104°F. Protection shall be provided to prevent moisture from entering the enclosure.

3.2 TESTING

- A. Perform factory and installation tests in accordance with applicable NEMA and UL requirements.
- B. Provide technically certified personnel on site to perform pre-energization tests and provide certificate of proper installation.
- C. During acceptance testing, provide technical personnel onsite with capability to diagnose errors, program MCC equipment and resolve any problems within the MCC system.
- D. Provide services of manufacturer's representative for testing and commission per Section 01 75 00.

3.3 TRAINING

- A. Provide 4 hours of onsite training for MCC maintenance.
- B. Training shall include instruction on programming equipment supplied within the MCC center including the Power Meter and VFDs.

END OF SECTION

SECTION 26 27 00

SERVICE AND DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section specifies requirements applicable to provide a new service and distribution system for the project. This may include such things as underground conduit, surface conduit, motors, control components and similar.
- B. Section includes:
 - 1. Scope.
 - 2. Definitions.
 - 3. Reference Standards.
 - 4. Quality Assurance.
 - 5. Submittals.
 - 6. Drawings.
 - 7. Project Site Conditions.
 - 8. Equipment Coordination.
 - 9. Basis of Design.
 - 10. Products.
 - 11. Execution – General.
 - 12. Testing.

1.2 SCOPE

- A. The following supplements all sections of this specification and applies to all work specified, shown on the drawings, or required to provide a complete installation of approved electrical systems.
- B. Work consists of providing the complete service and distribution system shown on the drawings and specified herein. The requirements of all other sections of the specification are equally applicable to the work to be performed under this section.

1.3 GENERAL

- A. Section 26 05 00, GENERAL ELECTRICAL REQUIREMENTS, which contain information and requirements that apply to the work specified herein and are necessary for this project.

1.4 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.

- d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
- C. Provide complete coordination study of the electrical system in accordance with 26 05 73. Include trip settings and trip curves for each overcurrent device provided in the project, including, but not necessarily limited to, the circuit breaker mounted in the generator, main circuit breaker/service disconnect, motor control center (MCC), motor starters, and panelboards. The coordination study shall conform to the requirements of the latest IEEE standard 242 – Protection and Coordination.
- D. The Contractor shall submit a coordination study report to the Engineer for review prior to project completion. The Engineer may direct the Contractor to make adjustments to trip settings based on the coordination study report findings. These adjustments shall be at no additional cost to the Owner.

1.5 ELECTRICAL SERVICE

- A. The utility company rendering electrical service to this project is Puget Sound Energy (PSE). Furnish all labor and install all material not furnished by the utility company, including meter bases, CT cans, and transformer pads or poles as shown, or as required by utility company to render service to the project from utility service point. Verify service point metering requirements, pad construction details, service charges, etc., and include all costs in bid proposal.
- B. Provide ground services as required to satisfy utility company and code requirements.
- C. Provide trenching and backfill at locations shown on the plans and as required by the utility company for service cable to the project site.
- D. For utility service conduit, provide sweeps per utility company standards.
- E. Verify all pull boxes, transformer details, and cable details with the utility company and observe utility company standards throughout.
- F. The Contractor shall pay all Power Company fees unless specified or noted otherwise.

1.6 SYSTEM VOLTAGE CHARACTERISTICS

- A. Provide electrical system nominal utilization voltage characteristics as follows:

Typical Voltage Description Herein	Nominal Utilization Voltage
480/277	460/265
120/208	115/200

PART 2 PRODUCTS

2.1 UTILITY METERING

- A. As shown in the drawings, provide a separate NEMA 3R EUSERC approved commercial metering switchboard section, bottom feed for underground service termination. Main lugs only ampere rating as shown in the drawings. Metering section shall include a metering and CT compartment, or as required by the Utility company to provide service to the project.

2.2 MAIN CIRCUIT BREAKER

- A. Furnish and install Main Circuit Breaker where indicated. Main circuit Breaker shall be enclosed in a NEMA 3R general purpose enclosure unless otherwise noted, with a front cover mounted metal nameplate that contains a permanent record of catalog number and maximum ratings, and a handle that is lockable in the "OFF" position. Enclosed Main Circuit Breaker shall be rated for "service entrance".
- B. Main Circuit Breaker shall be molded case and shall have the electrical characteristics, rating, and modifications as shown. Main Circuit Breaker shall have a quick-make, quick break, over-center toggle type, trip-free mechanism to prevent holding contacts closed against a position between "ON" and "OFF" when tripped automatically. Breaker shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously.
- C. The interrupting capacity of the Main Circuit breaker shall be at least equal to the available short circuit current at the line terminals of the breaker, but in no instance shall the rating be less than 42 kAIC at 480 volts.

PART 3 EXECUTION

3.1 EQUIPMENT BASES

- A. Provide equipment bases for all floor-mounted electrical equipment. Unless otherwise indicated, bases shall be poured-in-place concrete, nominally four inches high, and be one inch larger on all exposed edges than the equipment to be mounted. Provide additional surface-mounted channels where required to match and lineup with existing equipment. Provide concrete pads and mounting provisions for all exterior equipment as indicated on the drawings or specified in other portions of the specifications.

3.2 SUPPORTS

- A. Provide hangers or other devices such as pads, channels, struts, joists, anchors, etc., necessary for the support of electrical equipment. Provide the design, fabrication and erection of supplementary structural framing electrical equipment. Show on shop drawing supplementary framing including design loads, member size and location. When supplementary framing is indicated, verify that dimensions are suitable for the equipment furnished. Provide additional strength when equipment furnished is heavier than that specified.

3.3 DAMP AND WET LOCATION

- A. Provide 1/4-inch air space behind all electrical equipment mounted in damp and wet locations and on concrete walls below grade. Use corrosion-resistant washers, bolts and anchors.

3.4 START-UP AND TESTING

- A. The Contractor shall provide third party testing and certification of any ground fault circuit breakers per the NEC and/or State Codes.
 - 1. Set all circuit breakers, including the generator circuit breaker, per the coordination study specified herein.
- B. Provide Engineer with documentation on each setting of each circuit breaker as programmed. Omission of proper documentation shall result in start-up and testing Failure, and cause for the system to be re-tested and re-commissioned at the Contractor's expense.

END OF SECTION

SECTION 26 27 16

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Reference Standards.
 3. Quality Assurance.
 4. Submittals.
 5. Products.
 6. Execution.

1.2 SCOPE

- A. This Section specifies cabinets and enclosures for electrical equipment and is intended to compliment and augment other Division 26 sections

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
1. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NECA	National Electrical Installation Standards
NEMA ICS 4	Application Guideline for Terminal Blocks.
NFPA 70	National Electrical Code (NEC)

Reference	Title
UL 943	Ground-Fault Circuit Interrupters
UL 1010	Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. Listing and Labeling: Provide products that are Listed and Labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to the Authority Having Jurisdiction, and marked for intended use for the location and environment in which they are installed.
- C. Comply with NECA's "National Electrical Installation Standards."
- D. Comply with NFPA 70, as adopted and administered by the Authority Having Jurisdiction.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements,

with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
4. Manufacturer's Installation Instructions, including storage, handling, protection, examination, preparation, and installation of product.
5. Shop Drawings: Include layout drawings showing components and wiring for nonstandard enclosures, and cabinets.
6. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.

1.6 DELIVERY, STORAGE AND HANDLING

- A. PROCEDURES: Section 01 66 00
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 GENERAL

- A. Enclosures shall be UL approved for the application.
- B. MANUFACTURER: The enclosures shall be made by:
 - 1. Hoffmann Enclosures, Inc.
 - 2. Rittal.
 - 3. Bulletin A
 - 4. E. M. Wiegman and Co., Inc.
 - 5. Or Approved Equal

2.2 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250, Type 1, except as noted below, with continuous hinge cover and flush latch. Key latch to match panelboards.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: PVC or fiberglass, finished inside with radio-frequency-resistant paint.
 - 3. Application in other than NEMA 250, Type 1 environments:
 - a. Indoor Dusty Locations: NEMA 12.
 - b. Damp or Wet Locations: NEMA 3R.
 - c. Outdoor dirty/oily and washdown locations such as Aircraft Operations Areas: NEMA 4, stainless steel.
 - d. Damp or Wet and Corrosive Locations: NEMA 250, Type 4X, stainless steel.
 - e. Hazardous Locations: NEMA 250, Type 7, 8, or 9 depending on hazardous area classification and location (unhinged).

2.3 CABINETS

- A. Cabinets: NEMA 250, Type 1, except as noted below, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 1. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards.

2. Include metal barriers to separate wiring of different systems and voltage.
3. Include accessory feet where required for freestanding equipment.
4. Application in other than NEMA 250, Type 1 environments:
 - a. Indoor Dusty Locations: NEMA 12.
 - b. Damp or Wet Locations: NEMA 3R.
 - c. Outdoor dirty/oily and washdown locations: NEMA 4, stainless steel.
 - d. Damp or Wet and Corrosive Locations: NEMA 250, Type 4X, stainless steel.
 - e. Hazardous Locations: NEMA 250, Type 7, 8, or 9 depending on hazardous area classification and location (unhinged).

2.4 TERMINAL BLOCKS

- A. Minimum 600-volt rating for 480-volt circuits.
- B. Clamp or screw terminals sized for maximum conductor size.
- C. Separate connection point for each conductor.
- D. Ten percent spare terminal points.
- E. Individual identification for each terminal block.
- F. Phenolic block separators or barriers to isolate low-voltage and control terminations from analog and DC circuits.
- G. Terminal Blocks: NEMA ICS 4.
- H. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.
- I. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts.
- J. Provide ground bus terminal block, with each connector bonded to enclosure.

PART 3 EXECUTION

3.1 GENERAL

- A. Examine surfaces to receive enclosures, and cabinets for compliance with installation tolerances, access and working clearances. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 EXISTING WORK

- A. Remove abandoned cabinets and enclosures. Patch surfaces.
- B. Maintain access to existing cabinets and enclosures and other installations which remain active and which require access. Modify installation to provide access as appropriate.
- C. Extend existing cabinets and enclosures using materials and methods as specified.
- D. Clean and repair existing cabinets and enclosures which remain or are to be reinstalled.

3.3 INSTALLATION

- A. Install enclosures and cabinets as indicated, according to manufacturer's written instructions and in accordance with NECA "National Electrical Installation Standards."
- B. Install enclosures and cabinets plumb and level.

3.4 IDENTIFICATION

- A. Provide labels for enclosures and components as specified in Section 26 05 53 - Electrical Identification.
- B. Control Panels: Include panel designation, power source location, panel designation and circuit number.
- C. Equipment used in emergency systems shall be labeled "Suitable for use on emergency systems" per NEC 700-3.
- D. Instructional signs: Install approved legend where instructions or explanations are required for system or equipment operation.

3.5 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure coatings, finishes, and cabinets are without damage or deterioration at the time of Substantial Completion.

1. Repair damage to finishes with matching touchup coating recommended by manufacturer.

3.6 CLEANING

- A. On completion of installation, clean electrical parts and remove conductive and harmful materials
- B. Remove dirt and debris from enclosure.
- C. Clean finishes and touch up damage.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Reference Standards.
 3. Quality Assurance.
 4. Submittals.
 5. Products.
 6. Execution.

1.2 SCOPE

- A. This Section specifies general use wiring devices consisting of receptacles, plugs, switches and appurtenances. Also covered in this section are plugs and receptacles used for motor disconnecting or isolation means. See also 26 28 16.16 for enclosed disconnect switches.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
1. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NEMA 250	Enclosures for Electrical Equipment (1000 volts maximum)
NEMA WD-1	General Requirements for Wiring Devices
NEMA WD-6	Wiring Devices - Dimensional
NFPA 70	National Electrical Code (NEC)
UL 20	General-Use Snap Switches
UL 498	Attachment Plugs and Receptacles

Reference	Title
UL 514A	Metallic Outlet Boxes
UL 894	Switches for Use In Hazardous (Classified) Locations
UL 943	Ground-Fault Circuit Interrupters
UL 1010	Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.

PART 2 PRODUCTS

2.1 GENERAL

- A. Wiring devices shall be UL approved for the current and voltage specified and shall comply with NEMA WD-1. Devices shall contain provisions for back wiring and side wiring with captive binding screws.
- B. Provide devices colored to conform to manufacturer's or industry standard for special use such as orange for isolated ground receptacles, blue for surge suppression receptacles, and red for emergency power receptacles. Unless shown otherwise on the Drawings or Schedules, normal use devices shall be brown, except those located in finished areas shall be ivory.

2.2 RECEPTACLES AND PLUGS

- A. GENERAL: Receptacles shall be grounding type.
- B. 120V RECEPTACLES:
 1. INDOOR, CLEAN AREAS: Unless shown otherwise on the Drawings or Schedules, receptacles shall be duplex 20 amp, NEMA 5-20R, and shall accept NEMA 5-15P and 5-20P plugs. Where the manufacturer of cord connected equipment requires an isolated ground, a receptacle with isolated ground shall be provided.

- a. Manufacturers: Hubbell 5362, 5362-AI or approved equal.
 - b. Isolated ground receptacle manufacturers: Hubbell IG-5362, Arrow- Hart IG5362, or approved equal.
 - c. Receptacles shall be white in occupied areas with white faceplate.
 - d. Receptacles shall be grey in un-occupied areas with chrome faceplate.
 - e. Receptacles shall be mounted at 18 inches above floor unless otherwise indicated on plan drawings.
2. OUTDOOR, PROCESS OR CORROSIVE AREAS: Receptacle shall be duplex, 20 ampere, NEMA 5-20R, IP65/66/67, and shall accept NEMA 5- 15P and 5-20P plugs. Receptacle and plug shall be corrosion resistant, watertight, marine duty with yellow polycarbonate weatherproof lift covers.
- a. Manufacturers: Hubbell 60W33H/15W33H, or approved equal.
3. INDOOR/OUTDOOR, GROUND FAULT CURRENT INTERRUPTING: receptacle shall be duplex, 20 ampere, NEMA 5-20R and shall accept NEMA 5-15P and 5-20P plugs. Receptacle shall have LED indication of device fault and tripped condition. Receptacles shall meet the 2006 UL 943 standard for surge testing (3kA, 6kV) and requirement for “no power to face when miswired.”
- a. Manufacturers: Hubbel GF20Xx.
- C. 250V RECEPTACLES: Receptacles shall be duplex 20 amp, NEMA 6-20R, and shall accept NEMA 6-20P plug caps. Receptacles shall be Hubbell 60W48H, or approved equal.
- D. PLUG CAPS: Male plug caps for 120 volt and 250-volt receptacles shall be of the cord grip armored type with heavy phenolic housing, of the same manufacture as the receptacle. Plug caps shall be rated 15 amps. One plug cap shall be provided for every four receptacles furnished, with a minimum of two plug caps being provided. Plug caps shall be delivered to the Owner.
- E. THREE PHASE RECEPTACLES AND PLUGS: Receptacles shall be suitable for 480 volt, 3-phase, 4-wire service, with ampere ratings as specified. Receptacles and plugs shall be designed so that the grounding pole is permanently connected to the housing. The grounding pole shall make contact before the line poles are engaged when the plug is connected to the receptacle housing. The plug sleeve shall also make contact with the receptacle housing before the line and load poles make contact. Receptacles shall be provided complete with cast back box, angle adapter, gaskets, and a gasketed screw-type, weather tight cap with chain fastener. Each receptacle shall be provided with one plug.

1. Plugs and receptacles used for motor disconnecting and isolating means must be approved for such use.
 - a. Non Metallic IP66/67 and NEMA 4X rated. Poly
 - b. Disconnect rated.
 - c. Provide units with current and HP ratings as required.
 - d. Receptacles to include dead front shutter that deploys automatically when receptacle is removed.
 - e. Plugs to be provided with spring assisted latching mechanism to secure in place when plugged into matching receptacle.
 - 1) Latching mechanism to include quick release button.
 - f. Provide with two auxiliary / pilot contacts rated for 1.5 amps at 480 VAC.
 - 1) Where shown on the drawings or required by specific equipment, provide additional pilot contacts as required and as available within the product line.
 2. Manufacturers: Crouse-Hinds "Arktite," Appleton "Powertite," Meltric "DS" or "DSN" series approved equal.
- F. RECEPTACLES FOR HAZARDOUS AREAS: Receptacles for use in hazardous areas shall be rated in accordance with NEC for the area in which they are to be located and shall be factory sealed. Receptacles shall be designed so the plug must be inserted and turned before load is energized. Receptacles shall be provided with mounting box, sealing chamber, and compatible plug. Voltage and current ratings shall be 120 Vac, 20-ampere.
1. Manufacturers: Appleton "U-Line," Crouse-Hinds "Ark-Gard 2," or approved equal.

2.3 SWITCHES

- A. GENERAL PURPOSE (INDOOR, OCCUPIED AREAS): General purpose switches shall be rocker type, quiet AC type, specification grade, back and side wired, and shall be provided in accordance with rated capacities as required or as indicated on Drawings or Schedules. Switches shall match receptacles in color. Voltage and current ratings shall be 120VAC, 20-ampere.
1. Manufacturers: General Electric, Hubbell, or Owner accepted substitute.

B. GENERAL PURPOSE (INDOOR, UNOCCUPIED AREAS): General purpose switches shall be toggle type, quiet AC type, specification grade, back and side wired, and shall be provided in accordance with rated capacities as required or as indicated on Drawings or Schedules. Switches shall match receptacles in color. Voltage and current ratings shall be 120VAC, 20-ampere.

1. Manufacturers: General Electric, Hubbell, or Owner accepted substitute.

C. SWITCHES FOR HAZARDOUS AREAS: Switches for control of lighting and small single-phase power loads in hazardous areas shall consist of a factory assembled and sealed combination general purpose type switch in an explosion- proof housing. The switch shall be rated in accordance with NEC for the area in which it is to be installed. The external operating mechanism shall consist of a wing-type handle having the "ON" and "OFF" positions visible from the front.

1. Manufacturers: Crouse-Hinds EDS2129 series, Appleton EDS175 series, or approved equal.

D. SWITCHES FOR OUTDOOR AND CORROSIVE AREAS: Switches shall be 20- ampere with weatherproof/ corrosion resistant neoprene plate. Switches shall be mounted in "FD" type cast ferrous or cast ferrous PVC-coated boxes as specified.

1. Manufacturers: Hubbell or Arrow-Hart as follows:

Type	Hubbell with 17CM50 plate	Arrow-Hart with 2881 plate
Single-pole	1281	2991
Double-pole	1282	2992
3-way	1283	2993
4-way	1284	2994

2.4 DEVICE PLATES

A. RECEPTACLES AND SWITCHES (Occupied areas): Device plates shall be oversized, white, thermoplastic provided with switches. Lighting and exhaust fan switches located on the same wall shall share device plate.

B. RECEPTACLES AND SWITCHES (Un-Occupied areas):

1. In non-corrosive un-occupied indoor areas, device plates shall be made of sheet steel, zinc electroplated with chrome finish as manufactured by Crouse-Hinds, Appleton, or approved equal.

2. In corrosive indoor areas device plates shall be corrosion-resistant/marine- duty type. Plates shall be of the same manufacturer as the receptacle or switch.

3. In outdoor or wet areas receptacle covers shall provide while-in-use protection, rated NEMA 3R with cover closed. Covers shall be powder-coated cast zinc, with self-closing lid and stainless-steel hinges as manufactured by Leviton M5979 or approved equal.
 4. Device plates for explosion-proof equipment shall be factory provided with the equipment.
- C. Device plates shall be provided with engraved laminated phenolic nameplates with 1/8-inch white characters on black background.
1. Nameplates for switches shall identify panel and circuit number and area served (if remotely switched).
 2. Nameplates for receptacles shall identify circuit and voltage if other than 120 volts, single phase.

PART 3 EXECUTION

3.1 GENERAL

- A. Boxes shall be independently supported by galvanized brackets, expansion bolts, toggle bolts, or machine or wood screws as appropriate. Wooden plugs inserted in masonry or concrete shall not be used as a base to secure boxes, nor shall welding or brazing be used for attachment.
- B. Receptacles and switches installed in sheet steel boxes shall be flush mounted. Flush mounted receptacles shall be located 18 inches above the floor unless otherwise indicated. Switch boxes shall be mounted 48 inches above the floor. Receptacles installed in cast device boxes shall be located 48 inches above the floor.
- C. Wiring devices shall be tested for correct connections.

END OF SECTION

SECTION 26 28 16.13

ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Definitions
 - 5. Submittals.
 - 6. Coordination.
 - 7. Products.
 - 8. Execution.

1.2 SCOPE

- A. This section includes individually mounted enclosed switches and circuit breakers used for the following:
 - 1. Service disconnecting means.
 - 2. Feeder and branch-circuit protection.
 - 3. Motor and equipment disconnecting means.

1.3 REFERENCE STANDARDS

- A. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers.
- B. NEMA FU1 (National Electrical Manufacturers Association) - Low Voltage Cartridge Fuses.
- C. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NETA ATS (National Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- E. NFPA 70 (National Fire Protection Association) - National Electrical Code.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment first start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. RMS: Root mean square.
- C. SPDT: Single pole, double throw.

1.6 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
4. Field Test Reports: Submit written test reports and include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
5. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1 General Requirements. In addition to requirements specified in Section 01 77 00 - Project Closeout include the following:
 - a. Routine maintenance requirements for components.
 - b. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
 - c. Time-current curves, including selectable ranges for each type of circuit breaker.
6. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the submitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.

7. Shop Drawings: For each switch and circuit breaker.
 - a. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - 1) Enclosure types and details for types other than NEMA 250, Type 1.
 - 2) Current and voltage ratings.
 - 3) Short-circuit current rating.
 - 4) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 5) Include time-current coordination curves for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
8. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches, accessories, and components will withstand seismic forces defined in Section 01 41 20.
 - a. Basis of Certification: Verify whether withstand certification is based on actual test of assembled components.
 - 1) The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.”
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 DELIVERY, STORAGE AND HANDLING

- A. PROCEDURES: Section 01 45 00
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton
 - 2. General Electric
 - 3. Group Schneider/Square D
 - 4. Siemens
 - 5. Or Approved Equal

2.2 ENCLOSED CIRCUIT BREAKERS

- A. Enclosed Circuit Breakers
 - 1. Ground Fault protection type:
 - a. Required for solidly grounded wye service entrance switches over 150 Volts to ground, not exceeding 600 Volts and rated 1000 Amps and above.
 - 2. Switch Duty (SWD) rated type for switching lighting fixtures. Note that energy code restricts use of circuit breakers as sole means of switching lighting circuits. (See State of Washington Energy Code, Commercial Provisions C405.2.7)
 - 3. Auxiliary contacts: Provide as required by engineering considerations.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I²t response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
 6. GFCI Circuit Breakers: Single- and two-pole configurations with 5 mA or 30 mA trip sensitivity.
 7. Molded-Case Switch: Molded-case circuit breaker without trip units.
- C. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
 2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 4. Communication Capability: Circuit-breaker-mounted, Integral communication module with functions and features compatible with power monitoring and control system.
 5. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 6. Auxiliary Switch: Two SPDT switches with “a” and “b” contacts; “a” contacts mimic circuit-breaker contacts, “b” contacts operate in reverse of circuit-breaker contacts.

7. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 8. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
- D. Service Entrance: For enclosed circuit breakers identified for use as service equipment, provide solid neutral assembly and equipment ground bus.

2.3 ENCLOSURES

- A. NEMA AB 1, NEMA KS 1 and UL 50 to meet environmental conditions of installed location.
1. Indoor Clean Locations: NEMA 250, Type 1.
 2. Indoor Dusty Locations: NEMA 250, Type 12.
 3. Indoor Wet or Damp Locations and Outdoor Dirty/Oily or Washdown Locations: NEMA 250, Type 4.
 4. Outdoor Locations: NEMA 250, Type 3R.
 5. Corrosive Locations: NEMA 250, Type 4X, stainless steel.
 6. Hazardous Areas Indicated on Drawings: NEMA 250, Type [7] [8] [9].

2.4 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and tested enclosures before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 70 working space requirements and NECA 1.

- B. Standard Mounting Height: Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Operating handle typically at 5'-0" above grade or finished floor.
- C. Mount on substantial structure and secure to meet seismic zone 3 requirements. Comply with mounting and anchoring requirements specified in Section 01 41 20 - Seismic Requirements for Non-Structural Components and Systems.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses with rating indications facing outward.
- F. Set adjustable parameters and provide testing and calibration as required by engineering considerations.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53 - Electrical Identification.
- B. Install enclosure nameplate with switch or circuit breaker designation, power source, source location, voltage, load served and load location.
 - 1. Identify special conditions for shutting down load served.
- C. Apply label inside door cover identifying NEMA fuse class and size of fuses installed.
- D. Equipment used in emergency systems shall be labeled "Suitable for use on emergency systems" per NEC 700-3.

3.4 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
 - 1. Mark lugs after torquing with red paint such that paint will be visibly disturbed if lugs are disturbed.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to initially inspect, test, and adjust components, assemblies, and equipment installations, including connections. Verification will be by third party testing agency.
- B. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
 - 2. Test continuity of each line- and load-side circuit.
- C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 - 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 OPERATION AND MAINTENANCE MANUALS

- A. Comply with Section 01 78 23 - Operations and Maintenance Data and Part 1 of this specification.

END OF SECTION

SECTION 26 28 16.16

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Definitions
 - 5. Submittals.
 - 6. Coordination.
 - 7. Products.
 - 8. Execution.

1.2 SCOPE

- A. This section includes individually mounted enclosed switches and circuit breakers used for the following:
 - 1. Service disconnecting means.
 - 2. Feeder and branch-circuit protection.
 - 3. Motor and equipment disconnecting means.

1.3 REFERENCE STANDARDS

- A. NEMA AB 1 (National Electrical Manufacturers Association) - Molded Case Circuit Breakers.
- B. NEMA FU1 (National Electrical Manufacturers Association) - Low Voltage Cartridge Fuses.
- C. NEMA KS 1 (National Electrical Manufacturers Association) - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NETA ATS (National Electrical Testing Association) - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- E. NFPA 70 (National Fire Protection Association) - National Electrical Code.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment first start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 DEFINITIONS

- A. RMS: Root mean square.
- B. SPDT: Single pole, double throw.

1.6 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 - 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.

- a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
4. Shop Drawings: For each switch and circuit breaker.
- a. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - 1) Enclosure types and details for types other than NEMA 250, Type 1.
 - 2) Current and voltage ratings.
 - 3) Short-circuit current rating.
 - 4) Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 5) Include time-current coordination curves for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.
 - b. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - c. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
5. Manufacturer Seismic Qualification Certification: Submit certification that enclosed switches, accessories, and components will withstand seismic forces defined in Section 01 41 20.
- a. Basis of Certification: Verify whether withstand certification is based on actual test of assembled components.
 - 1) The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic

forces specified and the unit will be fully operational after the seismic event.”

- b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
6. Field Test Reports: Submit written test reports and include the following:
- a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
7. Manufacturer’s field service report.
8. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 1 General Requirements. In addition to requirements specified in Section 01 77 00 - Project Closeout include the following:
- a. Routine maintenance requirements for components.
 - b. Manufacturer’s written instructions for testing and adjusting switches and circuit breakers.
 - c. Time-current curves, including selectable ranges for each type of circuit breaker.

1.7 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Equipment shall be handled and stored in accordance with manufacturer’s instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

- B. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric.
 - 3. Group Schneider/Square D
 - 4. Siemens.
 - 5. Or Approved Equal.

2.2 ENCLOSED SWITCHES

- A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.
- B. Enclosed, Nonfusible Switch, heavy duty, double throw.
- C. Enclosed, Fusible Switch, 800A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handles with two padlocks, and interlocked with cover in closed position.
- D. Service Entrance: For switches identified for use as service equipment, provide solid neutral assembly and equipment ground bus.

2.3 ENCLOSURES

- A. NEMA AB 1, NEMA KS 1 and UL 50 to meet environmental conditions of installed location.
 - 1. Indoor Clean Locations: NEMA 250, Type 1.
 - 2. Indoor Dusty Locations: NEMA 250, Type 12.
 - 3. Indoor Wet or Damp Locations and Outdoor Dirty/Oily or Washdown Locations: NEMA 250, Type 4.
 - 4. Outdoor Locations: NEMA 250, Type 3R.
 - 5. Corrosive Locations: NEMA 250, Type 4X, stainless steel.

6. Hazardous Areas Indicated on Drawings: NEMA 250, Type [7] [8] [9].

2.4 FACTORY FINISHES

- A. Manufacturer's standard prime-coat finish ready for field painting.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and tested enclosures before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

- A. Comply with NFPA 70 working space requirements and NECA 1.
- B. Standard Mounting Height: Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Operating handle typically at 5'-0" above grade or finished floor.
- C. Mount on substantial structure and secure to meet seismic zone 3 requirements. Comply with mounting and anchoring requirements specified in Section 26 05 48 - Seismic Controls for Electrical and Communication Work.
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses with rating indications facing outward.
- F. Set adjustable parameters and provide testing and calibration as required by engineering considerations.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 26 05 53 - Electrical Identification.
- B. Install enclosure nameplate with switch or circuit breaker designation, power source, source location, voltage, load served and load location.

1. Identify special conditions for shutting down load served.
- C. Apply label inside door cover identifying NEMA fuse class and size of fuses installed.
- D. Equipment used in emergency systems shall be labeled "Suitable for use on emergency systems" per NEC 700-3.

3.4 CONNECTIONS

- A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.
- B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
 1. Mark lugs after torquing with red paint such that paint will be visibly disturbed if lugs are disturbed.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to initially inspect, test, and adjust components, assemblies, and equipment installations, including connections. Verification will be by third party testing agency.
- B. Prepare for acceptance tests as follows:
 1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
 2. Test continuity of each line- and load-side circuit.
- C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
 1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 OPERATION AND MAINTENANCE MANUALS

- A. Comply with Section 01 78 23 - Operations and Maintenance Data and Part 1 of this specification.

END OF SECTION

SECTION 26 29 24

ACTIVE FRONT END VARIABLE FREQUENCY CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products Requirements.
 - 6. Coordination.
 - 7. Products.
 - 8. Execution.

1.2 SCOPE

- A. This specification specifies active front end variable-frequency drives or controllers (VFDs), and variable frequency drives (VFDs). For the purpose of this specification the terms AFD and VFD are interchangeable and equivalent.
- B. The Variable-frequency Drive (VFD) system for motors rated 30Hp and larger shall use an Active Front End (AFE) Low Harmonic design and shall contain all components required to meet the performance, protection, safety and certification criteria of this specification.

Units shall utilize an insulated gate bipolar transistor (IGBT) technology as the input rectifier unit. This system shall be designed and configured such that IEEE 519 harmonic emission limits are inherently met without the need for external mitigation devices such as line reactors or filters.

- C. Refer to the drawings for control and monitoring requirements including special interlocking requirements.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI/IEEE C37.30A(1984)	Definitions and Requirements for High- Voltage Air Switches, Insulators, and Bus Supports, Supplement to C37.30-1971
ANSI C37.32	Schedules of Preferred Ratings, Manufacturing Specifications and Application Guide for High-Voltage Air Switches, Bus Supports, and Switch Accessories
NEMA ICS 1	General Standards for Industrial Controls and Systems
NEMA ICS 2	Standards for Industrial Control Devices, Controllers and Assemblies
NEMA ICS 3	Industrial Systems
NEMA ICS 3.1	Safety Standards for Construction and Guide for Selection, Installation and Operation of Variable-speed Drive Systems
NEMA ICS 4	Terminal Blocks for Industrial Control Equipment and Systems
NEMA ICS 6	Enclosures for Industrial Controls and Systems
ANSI C37.90	Relays and Relay Systems Associated with Electric Power Apparatus
IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
NFPA 70	National Fire Protection Association – US National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work
- B. The manufacturer shall warranty the above specified equipment for a period of twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design, workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
4. Catalog cuts shall be edited to show only the items, model numbers, and information which apply
5. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.
6. Installation instructions, outline dimensions and weights including filters and/or phase shifting autotransformers, front view drawing identifying control and monitoring devices, nameplate engravings, shipping section dimensions, weight, and foundation requirements or wall mounting requirements for all assemblies.
7. External connection diagram showing function and identification of all terminals requiring field connections.

8. O&M manuals per Section 01 33 00 and Section 26 05 00.
9. Product Data Sheets
 - a. VFD and Operator Interface publications.
 - b. Data sheets and publications on all major components including, but not limited to, the following:
 - 1) Contactors
 - 2) Circuit breaker and fuse (power and control)
 - 3) Control power transformers
 - 4) Pilot devices
 - 5) Relays/Timers
10. Schematics and wiring diagrams.
11. Plan drawings showing conduit entry locations.
12. Current and voltage distortion calculations.
 - a. Point of Common Coupling (PCC)
 - b. Include first 36 odd current and voltage harmonics. Voltage shall be calculated on line-to-line basis.
 - c. Provide distortion figures for each harmonic and the total demand distortion.
13. Efficiency and power factor calculations:
 - a. Calculate efficiencies of the VFD controller including the auto- transformer (where applicable), ventilation fans, control power and all VFD losses.
 - b. Calculate displacement and total power factor including filter.
 - c. Perform calculations at 100, 75, and 50 percent speed.
 - d. Include first 36 harmonics.
14. Harmonic Analysis Report that is project specific and includes the manufacturers statement of compliance with IEEE 519
15. Calculations of cooling and ventilation requirements.
16. Certified final factory test procedure and results for each drive.
17. Location and description of service center and spare parts stock.

18. Recommended spare parts list.
19. Factory and field test documentation.
20. Training schedule and materials.
21. Written descriptions explaining ladder diagram operation, system operation, and analog signal processing.
22. Comprehensive interconnection diagrams for VFD and motor.
23. In accordance with seismic anchoring requirements:
 - a. Certification of compliance with local code and seismic designation.
 - b. A sketch or description of the anchorage and restraint system.
24. Certification that VFD, motor, and driven load are compatible throughout the specified speed range.
25. Certified statement from the manufacturer accepting responsibility for providing a fully functioning installation as specified herein.

1.6 PRODUCT REQUIREMENTS

- A. The VFD system shall convert 460 volt, 60-Hertz nominal input to a suitable voltage and frequency to cause a premium efficient, inverter duty, squirrel-cage induction motor to run at a speed proportional to an external input analog 4 to 20 ma dc or digital input command as specified for the required VFD speed range.
- B. The VFD system shall include converter units, inverter units, control circuitry, protective equipment, load side DV/dt and sine wave filters, LCL filters and other filters and accessories as necessary to provide the specified functions to meet voltage and current harmonics at the specified point of common connection and to mitigate the motor reflected voltage wave. Unless otherwise specified, the point of common connection for VFDs shall be the 480V-distribution bus (motor control center, distribution panel, etc.) immediately upstream of the VFD.
- C. Active Front End Low Voltage Adjustable Frequency Drives.
 1. Listed and labeled by Underwriter's Laboratories, Inc. (UL), ETL, or Factory Mutual (FM).
 - a. All upgrades to specified requirements per UL or ETL.
 2. QUALITY ASSURANCE: The Owner reserves the right to observe factory tests on the VFD controller at the Owner's option and expense.

- a. All inspection and testing procedures shall be developed and controlled under the guidelines of the supplier's quality control system and must be registered to ISO 9001 and audited by a third party registrar.
- 3. COMPATIBILITY: VFD controller's performance shall be compatible and tolerant of disturbances produced by other VFD controllers and not interfere with each other.
- 4. PROGRAMMING: Provide VFD controller configuration and MACRO or sub-routine programming to meet specified driven equipment requirements.
- 5. MAINTAINABILITY: VFD controller's parts shall be interchangeable and modular for all controllers.
- D. FACTORY TEST: Subject complete VFD system to a complete simulated operational test. Drive a calibrated load at various speeds over the specified speed range to determine VFD efficiency.

1.7 DELIVERY, STORAGE AND HANDLING

- A. PROCEDURES: Section 01 66 00
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

1.8 COORDINATION

- A. Obtain and review the appropriate data for the driven motor and load over the required speed range, for a complete system analysis. Verify that equipment is mutually compatible and free of resonance over the complete operating range. Coordinate the assignment of any critical frequencies with the equipment suppliers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Variable frequency drives shall be as manufactured by the vendors listed below. The Owner will not consider substitutions. To conform with specified requirements, a manufacturer's standard product may require modification.

- 1. Allen Bradley Powerflex 755 TL

2.2 SYSTEM

- A. The System shall use a transistor-based Active Front End as the input rectifier that uses a Selective Harmonic Elimination algorithm, mitigating the harmonics enough to meet IEEE-519-2014 without the need for phase shifting transformers and multi-pulse diode rectifiers. Total current harmonic distortion shall not exceed 5% at the VFD input terminals at full load conditions. AFE rectifier shall be phase rotation insensitive, tolerant of line voltage imbalance up to 10% without affecting the harmonic mitigation or VFD output, and capable of operating the motor at full output with a 10% drop on input voltage.
- B. The unit shall use an LCL filter assembly to filter up to and including the 50th harmonic to reduce EMI/RFI emissions. The LCL filter assembly shall include Passive Dampening. The drive will provide Active Resonance Detection and Protection to minimize any damage to the drive from supply side resonance: Provide integrated, all solid-state variable frequency drives (VFD). Provide all components, with terminal numbers as shown on the Drawings.
- C. Operation: Accomplish speed control by adjusting the output frequency according to the desired reference speed. Adjust ac voltage and frequency simultaneously to provide the constant Volts/Hertz necessary to operate the motor at the desired speed. The VFD must use pulse width modulation (PWM) technology.
- D. The drive shall have a built-in circuit breaker as part of the drive's pre-charge circuit (250 hp and up) or provide built-in electrical connections for one to be field connected (10hp-250hp).
- E. The drive will have two sets of tuning settings for the configuration of the line side converter such that appropriate values can be selected for two input sources (example: main utility power or back-up generator) and can be selected from the Human Interface Module or communications network
- F. The VFD shall meet the voltage sag ride-through requirements of SEMI-F47.
- G. Incorporate phase-to-phase and phase-to-ground MOV protection on the AC input line.
- H. Microprocessor-based inverter and converter logic shall be isolated from power circuits.
- I. Use latest generation IGBT inverter and converter sections that shall not require commutation capacitors.
- J. Motor side inverters, line side converters and LCL filter modules (for drives greater than 250 Hp) shall be on roll-out chassis with front accessible connections for ease of repair or replacement and to provide access to load cables. Motor side inverter modules shall be removable without disturbing the load cables after installation.

- K. Line converter modules and load inverter modules sections (for drives greater than 250 Hp) shall be interchangeable so as to reduce necessary spare parts.
- L. Not used
- M. Rating:
 - 1. Line Voltage: 480 volts, -5 percent continuous, -10 percent momentary, +10 percent, 3- phase.
 - 2. Line Frequency: 60 Hz, ± 2 Hz
 - 3. Ambient Temperature: 5°C to 40°C
 - 4. Altitude: Up to 3,300 feet above sea level.
 - 5. Power Factor: Above 0.95 at full speed and rated load.
- N. Performance:
 - 1. Efficiency: Above 95 percent at 100 percent full speed, above 93 percent at 70 percent full speed.
 - 2. VFD Inrush Current: Limited to less than 100 percent of motor full load
 - 3. Duty Cycle: 6 starts per hour.
 - 4. Flying Start: The drive shall be capable of determining the speed and direction of a spinning motor and adjust its output to “pick-up” the motor at the rotating speed.
- O. Features:
 - 1. Provisions to accept the following control signals for automatic and manual operation:
 - a. Ethernet communications port support Ethernet/IP protocol. All operating parameters and control functions shall be accessible via Ethernet communications.
 - b. FWD & REV Run signal from a single remote contact closure when specified
 - c. A 4-20 mA dc signal for speed control. The VFD shall provide linear speed control of the motor from zero to full speed as the variable speed input signal varies from its minimum to maximum. Input impedance shall be 250 ohms resistive.
 - 2. Have a lineside converter input frequency range from 47 to 63 Hz

3. The carrier frequency of the lineside converter shall be fixed at 4 kHz.
4. The motor side inverter frequency output will be sine coded PWM with a carrier frequency that can be selected at 1.33 kHz, 2 kHz, or 4 kHz.
5. The VFD motor side inverter shall be capable of the following maximum frequency outputs:
 - a. 325 Hz when operating with an output carrier frequency of 1.33kHz or 2 kHz.
 - b. 590 Hz when operating with an output carrier frequency of 4kHz
6. Use gold plated plug-in connections on printed circuit boards.
7. Motor speed indicator calibrated in percent of full speed.
8. A 4-20 mA dc signal for remote speed indication to a local PLC. The VFD shall provide linear speed indication of the motor speed from zero to full speed. Input impedance shall be 250 ohms resistive.
9. A 4-20 mA dc signal for remote motor current indication to a local PLC. The VFD shall provide linear current indication of the motor from zero to full current. Input impedance shall be 250 ohms resistive.
10. Incoming line fused lockable disconnect or lockable main circuit breaker.
11. 24 VDC control circuitry and 480V-120V step down transformer.
12. Variable time delay for delaying motor drive restart after power failure; timer range shall be 0 to 120 seconds, with initial settings differing by 10 seconds for each drive; provide module which causes multiple attempts to restart.
13. Provision for automatic emergency shutdown in any mode, activated by the following:
 - a. Any additional abnormal conditions as shown on the Drawings. Provide for manual restart.
14. Auxiliary contacts for remote indication of "Run" and "VFD Fault."
15. VFD operable with motor disconnected, in order to test VFD.
16. Linearity and repeatability accuracy of 3 phase output of 1 percent of analog input control signal regardless of input power voltage fluctuations between 437 and 505 volts.

17. Independent acceleration and deceleration controls, adjustable from 2 to 30 Hz per second.

18. Label with fault current rating per NEC article 409.110 and arc flash warning label per NEC Article 110.16.

P. Motor Control

1. Selectable Sensorless Vector, Flux Vector, V/Hz, economizer mode selectable through programming.

2. The drive shall be supplied with an auto-tune mode.

3. The V/Hz mode shall be programmable for fan curve or full custom patterns.

4. Capable of Open Loop V/Hz.

5. Capable of operating induction and permanent magnet motors

6.

Q. Protection: Protect VFD against the following conditions:

1. Reverse phase sequence and single phasing of input power.

2. Input power failure.

3. Input transient voltages, including peak suppression and snubbers, in accordance with ANSI C37.90.

4. Transmission signal interference.

5. Output overcurrent.

6. Input overcurrent.

7. Motor over temperature.

8. Cabinet over temperature.

9. Under voltage: VFD shall automatically shut down if input voltage falls below preset limit with automatic restart upon return to a stable supply.

R. Enclosure Door Mounted Human Interface Module (HIM)

1. VFD shall provide a HIM with integral LCD display, operating keys and programming keys.

2. An enclosure door-mounted HIM, rated UL Type 12, shall be provided
 3. The HIM shall have the following features:
 4. A four (4) to seven (7) line backlit LCD display with graphics capability.
 5. Shall indicate drive operating conditions, adjustments and fault indications.
 6. Shall be configured to display in the following:
 7. One zone shall display the status of direction, drive condition, fault / alarm conditions and Auto / Manual mode.
 8. Another zone shall display drive output frequency, voltage or current.
 9. Another Zone shall display one of 6 to 12 user selected values such as power, torque, DC bus voltage, Analog values, discrete I/O status and etc.
 10. The keypad shall include programming keys, drive operating keys (Start, Stop, Direction, Jog and Speed Control), and numeric keys for direct entry.
- S. Construction:
1. All stand-alone VFDs provided for this project shall be of the same manufacturer chosen from Paragraph 2.1 above.
 2. VFDs mounted in motor control centers (MCCs) shall be of the same manufacturer as the MCC.
 - a. Door-mount the following devices:
 - 1) HMI with the following indications:
 - a) Power On
 - b) Speed indication
 - c) Motor Run
 - d) VFD Fault Indication
 - e) External operating handle for the incoming line fused disconnect.
 - b. Control components shall be in accordance Section 26 27 16. Configuration of the enclosure and the components shall be as shown on the drawings.
 - c. Components: Mount components on circuit cards or modules, which can be adjusted or replaced in the field without the use of special tools.
 - d. Finish: Paint finish shall be ANSI Grey.

- T. Spare Parts: Furnish two sets of spare power fuses for each size and type of fuse used; furnish a minimum of five fuses of each size and type of control circuit fuse.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 26 05 00 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Properly level and plumb VFDs so that doors will open and close freely.
- C. Clean and repair scratched or damaged surfaces to "new" condition.
- D. Provide the services of a factory trained service technician to inspect and check out each system before energizing.
- E. Per manufacturer's instructions, lace power conductors to resist short circuit forces.

3.2 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CLEANING

- A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.4 OPERATION AND MAINTENANCE MANUALS

- A. Comply with Section 01 77 00 - Project Closeout 01 78 23 - Operations and Maintenance Data and Part 1 of this specification.

3.5 COMPONENT TEST PHASE

- A. PROCEDURES: Section 01 75 16
- B. Operate each drive from no load to full load and perform a spectrum analysis to verify that the waveform on the line side of the VFD is in compliance with IEEE 519 for general systems.

3.6 MANUFACTURER'S SERVICES

- A. ON-SITE INSPECTIONS AND TRAINING: Provide a factory-trained manufacturer's representative at the Site for the following activities. Specified durations do not include travel time to or from the Site.
1. INSTALLATION INSPECTIONS: Assist, supervise, and inspect the Contractor's activities during installation. Provide minimum 2 hours of installation inspection for each VFD provided. If installation deficiencies are found, provide follow up inspections as required until a certificate of proper installation can be issued.
 2. PROGRAMMING: Provide programming of each VFD to operate as intended by the design and required by the installation. This includes but is not limited to the following:
 - a. Set all VFD parameters as required for the installation. This includes
 - 1) Motor nameplate information
 - 2) Standard and optional VFD I/O configuration settings to match installed environment
 - 3) Tune the VFD for the motor connected.
 - a) Provide spinning tune if possible and static Motor ID and tune if operating motor is not possible.
 3. TRAINING SESSIONS: Procedures: Section 01 75 16. Coordinate training with operations and maintenance staff schedules to ensure all required staff can attend. Training must meet the requirements of division 01 and division 40 general conditions as well as the specific requirements included herein.
 - a. Training to include providing a written copy of all non default VFD settings as well as step by step instructions for making setting changes via the keypad or using vendor provided configuration software.

END OF SECTION

SECTION 26 32 13

DIESEL-ENGINE GENERATORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Product Requirements.
 - 6. Installation.
 - 7. Testing.

1.2 SCOPE

- A. This Section includes packaged engine-generator sets suitable for use in mission critical applications with sub-base diesel tank and fuel transfer pump as specified and indicated. Engine generators will be used as the Standby power source for the system, but shall be capable of providing reliable power with no run-time limitations while the primary source of power is unavailable.
- B. Coordinate with Automatic Transfer Switch. Ensure required control and status signals are present and align on a per point basis between the generator and the ATS.

1.3 REFERENCE STANDARDS

- A. NFPA 37 (Standard For the Installation and Use of Stationary Combustion Engines and Gas Turbines).
- B. NFPA 70 (National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702).
- C. NFPA 110 (Emergency and Standby Power Systems) requirements for Level 1 emergency power supply system.
- D. Comply with UL 2200.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work

- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing equipment of types and capacities similar to those indicated for this Project and with a service center maintained by engine generator set manufacturer capable of providing training, parts, and emergency maintenance and repairs at the Project site with 24 hours maximum response time.
- C. Source Limitations: Obtain engine generator set and auxiliary components from a single manufacturer with responsibility for entire system.
- D. Listing and Labeling: Provide system components of types and ratings for which listing or labeling service is established and components specified in this Section that are listed and labeled.
 - 1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.
- E. Comply with NFPA 70.
- F. Comply with NFPA 99.
- G. Comply with NFPA 704, Hazard Identification signage.
- H. Engine Exhaust Emissions: Comply with applicable federal, state, and local government requirements.
- I. The manufacturer shall warranty the above specified equipment for 5 years from equipment start-up and commissioning to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
- C. Catalog cuts shall be edited to show only the items, model numbers, and information which apply
- D. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
 1. Thermal damage curve for generator.
 2. Time-current characteristic curves for generator protective device.
 3. Sound test data, based on a free field requirement as measured and not calculated
- E. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, and location and size of each field connection.
 1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
 2. Wiring Diagrams: Control interconnection, Customer connections.
- F. Load Calculations

1. Provide manufacturers load calculations that demonstrate the generator has been properly sized for the application.
 - a. Obtain load information from the one line diagram and or the load summary.
 - b. Develop step and load starting sequence that corresponds to the logical operation of the facility.
 - 1) Step sequencing shall assume all hardwired and non-automated equipment starts on step one.
 - 2) Subsequent steps shall begin with starting of largest motors first and then transition to smaller.
 - 3) Step sequence to be confirmed by the owner and engineer.

G. Certifications:

1. Submit statement of compliance which states the proposed product(s) is certified to the emissions standards required by the location for EPA, stationary emergency application.
2. Submit statement of compliance which states the proposed product(s) are seismically certified in compliance with local requirements signed and sealed by a qualified professional engineer.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer Seismic Qualification Certification: Submit certification that the 9 Hour(s) fuel tank, the Sound Attenuated enclosure, engine-generator set, and components will withstand seismic forces defined in 01 41 20 and including the following:
1. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- B. Source quality-control test reports.
1. Certified summary of prototype-unit test report. See requirements in Part 2 "Source Quality Control" Article Part A. Include statement indicating torsional compatibility of components.

2. Certified Test Report: Provide certified test report documenting factory test per the requirements of this specification, as well as certified factory test of generator set sensors per NFPA110 level 1.
3. List of factory tests to be performed on units to be shipped for this Project.
4. Report of exhaust emissions and compliance statement certifying compliance with applicable regulations.

1.7 PROJECT CONDITIONS

- A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
 1. Ambient Temperature: 10.0 deg F to 110.0 deg F.
 2. Relative Humidity: 0 to 95 percent.
 3. Altitude: Sea level to 1000.0 feet (110.0 m).

1.8 DELIVERY, STORAGE AND HANDLING

- A. PROCEDURES: Section 01 40 00
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: The basis for this specification is Cummins Power Generation equipment, equal units by Caterpillar and Kohler may be considered if equipment performance is shown to meet the requirements herein.

2.2 ENGINE-GENERATOR SET

- A. Factory-assembled and -tested, engine-generator set.

- B. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
 - 1. Rigging Information: Indicate location of each lifting attachment, generator-set center of gravity, and total package weight in submittal drawings.
- C. Capacities and Characteristics:
 - 1. Power Output Ratings: Electrical output power rating for Standby operation of not less than 500 kW, at 80 percent lagging power factor, 277/480, Series Wye, Three phase, 4 -wire, 60 hertz.
 - 2. Alternator shall be capable of accepting maximum 1749.0 kVA in a single step and be capable of recovering to a minimum of 90% of rated no load voltage. Following the application of the specified kVA load at near zero power factor applied to the generator set.
 - 3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of components. The engine-generator nameplate shall include information of the power output rating of the equipment.
- D. Generator-Set Performance:
 - 1. Steady-State Voltage Operational Bandwidth: 0.5 percent of rated output voltage from no load to full load.
 - 2. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 3 seconds. On application of a 100% load step the generator set shall recover to stable voltage within 10 seconds.
 - 3. Steady-State Frequency Operational Bandwidth: 0.25 percent of rated frequency from no load to full load.
 - 4. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
 - 5. Transient Frequency Performance: not more than 3 percent variations for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within 3 seconds. On application of a 100% load step the generator set shall recover to stable frequency within 10 seconds.
 - 6. Output Waveform: At full load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for any single harmonic.

Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50.

7. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 8 seconds without damage to generator system components. For a 1-phase, bolted short circuit at system output terminals, system shall regulate both voltage and current to prevent over-voltage conditions on the non-faulted phases.
8. Start Time: Comply with NFPA 110, Level 1, Type 10, system requirements.
9. Ambient Condition Performance: Engine generator shall be designed to allow operation at full rated load in an ambient temperature under site conditions, based on highest ambient condition. Ambient temperature shall be as measured at the air inlet to the engine generator for enclosed units, and at the control of the engine generator for machines installed in equipment rooms.
10. Load Sharing: Engine generator shall share real and reactive load proportionally within plus or minus 3 percent with all other engine generators in the system.

2.3 ENGINE

- A. Fuel: ASTM D975 #2 Diesel Fuel
- B. Rated Engine Speed: 1800RPM.
- C. Lubrication System: The following items are mounted on engine or skid:
 1. Lube oil pump: shall be positive displacement, mechanical, full pressure pump.
 2. Filter and Strainer: Provided by the engine manufacturer of record to provide adequate filtration for the prime mover to be used.
 3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.
- D. Engine Fuel System: The engine fuel system shall be installed in strict compliance to the engine manufacturer's instructions
- E. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.

- F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity and performance.
 - 1. Designed for operation on a single 240 VAC, Single phase, 60Hz power connection. Heater voltage shall be shown on the project drawings.
 - 2. Installed with isolation valves to isolate the heater for replacement of the element without draining the engine cooling system or significant coolant loss.
 - 3. Provided with a 24VDC thermostat, installed at the engine thermostat housing
- G. Governor: Adjustable isochronous, with speed sensing. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate as appropriate to the state of the engine generator. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous states.
- H. Cooling System: Closed loop, liquid cooled
 - 1. The generator set manufacturer shall provide prototype test data for the specific hardware proposed demonstrating that the machine will operate at rated standby load in an outdoor ambient condition of 40 deg C.
 - 2. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
 - 3. Size of Radiator overflow tank: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
 - 4. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.
 - 5. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
 - 6. Duct Flange: Generator sets installed indoors shall be provided with a flexible radiator duct adapter flange.
- I. Muffler/Silencer: Selected with performance as required to meet sound requirements of the application, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure

requirements. For generator sets with outdoor enclosures the silencer shall be inside the enclosure.

1. Exhaust Silencers shall have high temp black paint finish for corrosion resistance.
 2. Make provisions as required for pipe expansion and contraction. Contractor shall cover exhaust silencers (where mounted indoors) and all indoor exhaust piping with a proper insulating material in a manner not to interfere with flexible exhaust connection(s).
 3. Provide flexible exhaust connection as shown for connection between engine exhaust manifold(s) and exhaust line. Provide an exhaust condensation trap with manual drain valve to trap and drain off exhaust condensation and to prevent condensation from entering the engine.
- J. Air-Intake Filter: Engine-mounted air cleaner with replaceable dry-filter element and restriction indicator.
- K. Starting System: 24VDC with negative ground.
1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
 2. Cranking Cycle: As required by NFPA 110 for level 1 systems.
 3. Battery Cable: Size as recommended by engine manufacturer for cable length as required. Include required interconnecting conductors and connection accessories.
 4. Battery Compartment: Factory fabricated of metal with acid-resistant finish.
 5. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation. The battery charging alternator shall have sufficient capacity to recharge the batteries with all parasitic loads connected within 4 hours after a normal engine starting sequence.
 6. Battery Chargers: Unit shall comply with UL 1236, provide fully regulated, constant voltage, current limited, battery charger for each battery bank. It will include the following features:
 - a. Operation: Equalizing-charging rate based on generator set manufacturer's recommendations shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.

- b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 20 deg C to plus 40 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
- c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
- d. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
- e. Provide LED indication of general charger condition, including charging, faults, and modes. Provide a LCD display to indicate charge rate and battery voltage. Charger shall provide relay contacts for fault conditions as required by NFPA110.
- f. Enclosure and Mounting: NEMA, Type 1, wall-mounted cabinet.

2.4 FUEL OIL STORAGE

- A. Comply with NFPA 30.
- B. Sub Base-Mounted Fuel Oil Tank: Provide a double wall secondary containment type sub base fuel storage tank. The tank shall be constructed of corrosion resistant steel and shall be UL 2085 listed and labeled in non-secure areas and UL-142 rated in areas where vandalism and physical damage are not likely. The fuel tank shall include the following features:
 - 1. Capacity: Sufficient fuel for 24 hours continuous operation at 100 percent rated power output.
 - 2. Tank rails and lifting eyes shall be rated for the full dry weight of the tank, genset, and enclosure.
 - 3. Electrical stub up(s)
 - 4. Normal & emergency vents
 - 5. Lockable fuel fill
 - 6. Mechanical fuel level gauge
 - 7. High and low level switches to indicate fuel level

8. Leak detector switch
9. Sub base tank shall include a welded steel containment basin, sized at a minimum of 130% of the tank capacity to prevent escape of fuel into the environment in the event of a tank rupture.
10. Fill port with overfill prevention valve (OFPV)
11. 5-gallon fill/spill dam or bucket
12. Tank design shall meet the regional requirements for the Project location

2.5 CONTROL AND MONITORING

- A. Engine generator control shall be microprocessor based and provide automatic starting, monitoring, protection and control functions for the unit.
- B. Automatic Starting System Sequence of Operation: When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. (Switches with different configurations but equal functions are acceptable.) When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- C. Manual Starting System Sequence of Operation: Switching on-off switch on the generator control panel to the on position starts generator set. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of the local (generator set-mounted) and/or remote emergency-stop switch also shuts down generator set.
- D. Configuration: Operating and safety indications, protective devices, system controls, engine gages and associated equipment shall be grouped in a common control and monitoring panel. Mounting method shall isolate the control panel from generator-set vibration. AC output power circuit breakers and other output power equipment shall not be mounted in the control enclosure.
- E. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
 1. AC voltmeter (3-phase, line to line and line to neutral values).
 2. AC ammeter (3-phases).

3. AC frequency meter.
4. AC kW output (total and for each phase). Display shall indicate power flow direction.
5. AC kVA output (total and for each phase). Display shall indicate power flow direction.
6. AC Power factor (total and for each phase). Display shall indicate leading or lagging condition.
7. Ammeter-voltmeter displays shall simultaneously display conditions for all three phases.
8. Emergency Stop Switch: Switch shall be a red “mushroom head” pushbutton device complete with lock-out/tag-out provisions. Depressing switch shall cause the generator set to immediately stop the generator set and prevent it from operating.
9. Fault Reset Switch: Supply a dedicated control switch to reset/clear fault conditions.
10. DC voltmeter (alternator battery charging).
11. Engine-coolant temperature gauge.
12. Engine lubricating-oil pressure gauge.
13. Running-time meter.
14. Generator-voltage and frequency digital raise/lower switches. Rheostats for these functions are not acceptable. The control adjustment of these parameters shall be in a range of plus or minus 5% of the voltage and frequency operating set point (not nominal voltage and frequency values.)
15. Fuel tank derangement alarm.
16. Fuel tank high-level shutdown of fuel supply alarm.
17. AC Protective Equipment: The control system shall include over/under voltage, reverse kVAR, reverse kW, over load (kW) short circuit, over current, loss of voltage reference, and over excitation shut down protection. There shall be a ground fault alarm for generator sets rated over 1000 amps, overload warning, and overcurrent warning alarm.

18. Status LED indicating lamps to indicate remote start signal present at the control, existing shutdown condition, existing alarm condition, not in auto, and generator set running.
 19. A graphical display panel with appropriate navigation devices shall be provided to view all information noted above, as well as all engine status and alarm/shutdown conditions (including those from an integrated engine emission control system). The display shall also include integrated provisions for adjustment of the gain and stability settings for the governing and voltage regulation systems.
 20. Panel lighting system to allow viewing and operation of the control when the generator room or enclosure is not lighted.
 21. Data Logging: The control system shall log the latest 20 different alarm and shut down conditions, the total number of times each alarm or shutdown has occurred, and the date and time the latest of these shutdown and fault conditions occurred.
 22. DC control Power Monitoring: The control system shall continuously monitor DC power supply to the control, and annunciate low or high voltage conditions. It shall also provide an alarm indicating imminent failure of the battery bank based on degraded voltage recover on loading (engine cranking).
- F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
1. Overcrank shutdown.
 2. Coolant low-temperature alarm.
 3. Control switch not in auto position.
 4. Battery-charger malfunction alarm.
 5. Battery low-voltage alarm.
- G. Remote Alarm Annunciator: Comply with NFPA 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition.

2.6 GENERATOR OVERCURRENT AND FAULT PROTECTION

- A. Main Circuit Breaker: Provide a generator mounted circuit breaker, molded case, 3 pole, NEMA 1/IP22, which will disconnect the generator from the supply circuit. Circuit breaker to be sized as shown. Breaker shall utilize a solid-state trip unit and shall have the electrical characteristics, rating, and modifications as shown. The breaker shall be UL/CSA Listed and connected to engine/generator safety shutdowns. Breaker shall be

housed in an extension terminal box which is isolated from vibrations induced by the generator set and shall have a metal nameplate that contains a permanent record of the circuit breaker catalog number and maximum ratings. Mechanical type lugs, sized for the circuit breaker feeders shown on drawing, shall be supplied on the load side of breaker.

1. Circuit breaker trip system shall be a microprocessor-based true rms sensing designed with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on the associated drawing. The solid-state trip circuit breaker shall include the following adjustments; each adjustment shall have discrete settings (fully adjustable) and shall be independent of all other adjustments:
 - a. An ampere trip setting (long time pickup) that is adjustable from 0.5 times (or less) to 1.0 times the plug ampere rating, in 0.1 (or less) increments.
 - b. An adjustable long time pickup delay, with a minimum of 5 different delay settings.
 - c. A short time pickup trip setting that is adjustable from 2 times (or less) to 9 (or greater) the long time ampere trip setting.
 - d. An adjustable short time pickup delay, with a minimum of 5 different delay settings.
 - e. An instantaneous pickup that is capable of being disabled (preferable) or is adjustable from 1.5 times (or less) to 15 times (or greater) the long time ampere trip setting. Units that are capable of disabling the instantaneous pickup shall be configured with the instantaneous pickup disabled.
 2. Main Circuit Breaker shall have a quick-make, quick break, over-center toggle type, trip-free mechanism to prevent holding contacts closed against a position between "ON" and "OFF" when tripped automatically. Breaker shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously.
 3. The interrupting capacity of the Main Circuit Breaker shall be 42 kAIC at 480 volts, minimum.
- B. Load Bank Circuit Breaker: Provide a generator mounted circuit breaker, molded case, 3 pole, NEMA 1/IP22, which will connect the generator to a portable load bank. Circuit breaker to be sized as shown. Breaker shall be of standard thermal magnetic design. Breaker shall be housed in an extension terminal box which is isolated from vibrations induced by the generator set and shall have a metal nameplate that contains a

permanent record of the circuit breaker catalog number and maximum ratings. Mechanical type lugs shall be supplied on the load side of breaker.

1. Circuit Breaker shall have a quick-make, quick break, over-center toggle type, trip-free mechanism to prevent holding contacts closed against a position between "ON" and "OFF" when tripped automatically. Breaker shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously.
 2. The interrupting capacity of the circuit breaker shall be 10 kAIC at 480 volts, minimum.
- C. Generator Overcurrent Protection: The generator set shall be provided with a UL Listed/CSA Certified protective device that is coordinated with the alternator provided to prevent damage to the generator set on any possible overload or overcurrent condition external to the machine. The protective device shall be listed as a utility grade protective device under UL category NRGU. The control system shall be subject to UL follow-up service at the manufacturing location to verify that the protective system is fully operational as manufactured. Protector shall perform the following functions:
1. Initiates a generator kW overload alarm when generator has operated at an overload equivalent to 110 percent of full-rated load for 60 seconds. Indication for this alarm is integrated with other generator-set malfunction alarms.
 2. Under single phase or multiple phase fault conditions, or on overload conditions, indicates an alarm conditions when the current flow is in excess of 110% of rated current for more than 10 seconds.
 3. Under single phase or multiple phase fault conditions, operates to switch off alternator excitation at the appropriate time to prevent damage to the alternator.
 4. The operator panel shall indicate the nature of the fault condition as either a short circuit or an overload.
 5. Senses clearing of a fault by other overcurrent devices and controls recovery of rated voltage to avoid overshoot greater than 120% of nominal voltage.
 6. The protective system provided shall not include an instantaneous trip function.
- D. Ground-Fault Indication: Comply with NFPA 70, "Emergency System" signals for ground-fault. Integrate ground-fault alarm indication with other generator-set alarm indications.

2.7 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

- A. Comply with NEMA MG 1.
- B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.
- C. Electrical Insulation: Class H
- D. Temperature Rise: 125 / Class H environment.
- E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, over speed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.
- F. Permanent Magnet Generator (PMG) shall provide excitation power for optimum motor starting and short circuit performance.
- G. Enclosure: Drip-proof.
- H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified. The voltage regulation system shall be microprocessor-controlled, 3-phase true RMS sensing, full wave rectified, and provide a pulse-width modulated signal to the exciter. No exceptions or deviations to these requirements will be permitted.
- I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.
- J. Subtransient Reactance: 12 percent maximum, based on the rating of the engine generator set.

2.8 OUTDOOR GENERATOR-SET ENCLOSURE

- A. Description: Sound Attenuated Steel housing. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Instruments, control, and battery system shall be mounted within enclosure.
- B. Construction:
 - 1. Louvers: Equipped with bird screen to permit air circulation when engine is not running while excluding birds and rodents.
 - 2. Hinged Doors: With padlocking provisions. Restraint/Hold back hardware to prevent door to keep door open at 180 degrees during maintenance. Rain lips over all doors.
 - 3. Exhaust System:

- a. Muffler Location: Within enclosure.
- 4. Hardware: All hardware and hinges shall be stainless steel.
- 5. Mounting Base: Suitable for mounting on sub-base fuel tank or housekeeping pad.
- 6. A weather protective enclosure shall be provided which allows the generator set to operate at full rated load with a static pressure drop equal to or less than 0.5 inches of water.
- 7. Inlet ducts shall include rain hoods
- C. Engine Cooling Airflow through Enclosure: Housing shall provide ample airflow for engine generator operation at rated load in an ambient temperature of 40 deg C.
 - 1. Louvers: Fixed-engine, cooling-air inlet and discharge.
- D. Sound Performance: Reduce the sound level of the engine generator while operating at full rated load to a maximum of 75 dBA measured at any location 7 m from the engine generator in a free field environment.
- E. Distribution Panel: Provide an internally mounted and wired electrical distribution panel to serve the engine generator and enclosure; including:
 - 1. 100 amp distribution panelboard connected to a 120/240VAC utility service by the installer.
 - 2. Two duplex GFI receptacles, one inside the enclosure, and a weatherproof receptacle on the outside of the enclosure.
 - 3. Factory wired normal AC service from the panelboard to the engine coolant heater, alternator heater, and battery charger.
 - 4. Interior Lights with Switch: Two three-way switches controlling three LED lamps mounted in vapor tight and gasketed fixtures
- F. Site Provisions:
 - 1. Lifting: Complete assembly of engine generator, enclosure, and sub base fuel tank (when used) shall be designed to be lifted into place as a single unit, using spreader bars.

2.9 VIBRATION ISOLATION DEVICES

- A. Vibration Isolation: Generators installed on grade shall be provided with elastomeric isolator pads integral to the generator, unless the engine manufacturer requires use of spring isolation.

1. IBC Compliance: Isolators complying with IBC requirements shall be specified in the equipment documentation, as well as the installation requirements for the unit.

2.10 FINISHES

- A. Indoor and Outdoor Enclosures and Components: Powder-coated and baked over corrosion-resistant pretreatment and compatible primer. Manufacturer's standard color or as directed on the drawings.

2.11 SOURCE QUALITY CONTROL

- A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
 1. Tests: Comply with NFPA 110, Level 1 Energy Converters. In addition, the equipment engine, skid, cooling system, and alternator shall have been subjected to actual prototype tests to validate the capability of the design under the abnormal conditions noted in NFPA110. Calculations and testing on similar equipment which are allowed under NFPA110 are not sufficient to meet this requirement.
- B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:
 1. Test engine generator set manufactured for this Project to demonstrate compatibility and functionality.
 2. Full load run.
 3. Maximum power.
 4. Voltage regulation.
 5. Steady-state governing.
 6. Single-step load pickup.
 7. Simulated safety shutdowns.
 8. Provide 14 days' advance notice of tests and opportunity for observation of tests by Owner's representative.
 9. Test third party factory installed load bank to demonstrate automatic capability to maintain 50 percent load to guard against wet stacking.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Comply with packaged engine-generator manufacturers' written installation, application, and alignment instructions and with NFPA 110.
- B. Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable state and local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.
- C. Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- D. Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- E. Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the consulting engineer.
- F. All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.
- G. On completion of the installation by the electrical contractor, the generator set supplier shall conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.

3.2 CLEANING

- A. Upon completion of installation, inspect system components. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish. Clean components internally using methods and materials recommended by manufacturer.

3.3 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 OPERATION AND MAINTENANCE MANUALS

- A. Comply with Section 01 78 23 - Operations and Maintenance Data and Part 1 of this specification.

3.5 ON-SITE ACCEPTANCE TEST

- A. The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer shall be notified in advance and shall have the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system.
- B. Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
- C. Installation acceptance tests to be conducted on site shall include a "cold start" test, a two hour full load (resistive) test, and a one-step rated load pickup test in accordance with NFPA 110. Provide a resistive load bank and make temporary connections for full load test, if necessary.
- D. Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.

3.6 TRAINING

- A. The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration and the class size shall be limited to 5 persons. Training date shall be coordinated with the facility owner.

3.7 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise installation and connection of the generator-set unit and to report results in writing.
- B. Supervised Adjusting and Pretesting: Under supervision of factory-authorized service representative, pretest all system functions, operations, and protective features. Provide all instruments and equipment required for tests. Adjust to ensure operation

is according to Specifications. Load system using a variable resistive load bank simulating kW of loads for which unit is rated.

3.8 SERVICE AND SUPPORT

- A. The generator set supplier shall maintain service parts inventory for the entire power system at a central location which is accessible to the service location 24 hours per day, 365 days per year. The inventory shall have a commercial value of \$3 million or more. The manufacturer of the generator set shall maintain a central parts inventory to support the supplier, covering all the major components of the power system, including engines, alternators, control systems, and power transfer equipment.
- B. The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical power system replacement parts in the local service location. Service vehicles shall be stocked with critical replacement parts. The service organization shall be on call 24 hours per day, 365 days per year. The service organization shall be physically located within 2 hours from the site.
- C. The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.

3.9 SPARE PARTS

- A. Provide the following spare parts for each generator unit
 - 1. Three sets fuel oil filter elements and gaskets.
 - 2. Three lubricating oil filter elements and gaskets.
 - 3. One air cleaner filter element.
 - 4. One set of coolant hoses
 - 5. Two sets V-belts for accesopry
 - 6. Fuses: 1 for every 10 of each type and rating, but not less than 1 of each.

3.10 SERVICE AGREEMENT

- A. The supplier shall include in the base price, a one-year service agreement. The maintenance shall be performed by factory authorized service technicians capable of servicing both the engine generator set. This agreement shall include the following:
 - 1. Generator supplier must have an in-house rental fleet with equipment sized to back up this project site.
 - 2. All engine maintenance as recommended by the service manual.
 - 3. All electrical controls maintenance and calibrations as recommended by the manufacturer.

4. All auxiliary equipment as a part of the emergency systems.
5. The supplier shall guarantee emergency service.
6. All expendable maintenance items are to be included in this agreement.
7. A copy of this agreement and a schedule shall be given to the Owner at the time of his acceptance, showing what work is to be accomplished and when.

END OF SECTION

SECTION 26 36 23

AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. System Requirements
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. The Contractor shall furnish and install Automatic Transfer Switch (ATS) with number of poles, amperage, voltage, and withstand current ratings as shown on the drawings. Each automation transfer shall consist of a contactor style **or** inherently double throw power transfer switch mechanism and a microprocessor controller, interconnected to provide complete automatic operation.
- B. Coordinate with the Generator Supplier to ensure proper interconnection of the generator and ATS and generator and that proper operation of the generator will be assured.

1.3 SYSTEM REQUIREMENTS

- A. The ATS shall be Rated for use at 480 VAC, 800 amps with a withstand rating of 65,000 AIC unless otherwise shown on the drawings. Unit shall be 3 pole with a solid neutral unless shown or specified differently on the drawing. Unit shall be Delayed Transition style.

1.4 QUALITY ASSURANCE

A. REFERENCE STANDARDS

- 1. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.
 - a. UL 1008 - Standard for Automatic Transfer Switches
 - b. CSA 22.2 No 178
 - c. IEC 60947-6-1
 - d. NFPA 70 - National Electrical Code
 - e. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
 - f. NEC Articles 700, 701, 702
 - g. NFPA 110 - Emergency and Standby Power Systems
 - h. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
 - i. International Standards Organization ISO 9001: 2008
 - j. UL 508 Industrial Control Equipment

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be

provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 4. Catalog cuts shall be edited to show only the items, model numbers, and information which apply
 5. Installation instructions, outline dimensions and weights, front view drawing identifying control and monitoring devices, nameplate engravings, shipping dimensions, weight, and wall mounting requirements.
 6. Certification from the project generator supplier that the ATS provides all the features and functions required to monitor and control their generator adequately.
 7. Component list
 8. Conduit entry/exit locations where applicable
 9. Assembly ratings including:
 - a. Short-circuit rating
 - b. Voltage
 - c. Continuous current
 10. Cable terminal sizes
 11. Product data sheets, external connection diagram showing function and identification of all terminals requiring field connections.

12. O&M manuals per Section 01 33 00 and Section 26 05 00.
13. Schematics and wiring diagrams.
14. Recommended spare parts list.
15. Factory test documentation.
16. In accordance with seismic anchoring requirements:
 - a. Certification of compliance with local code and seismic designation.
 - b. A sketch or description of the anchorage and restraint system.

1.6 DELIVERY, STORAGE AND HANDLING

- A. PROCEDURES: Section 01 66 00
- B. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- C. Store indoors in clean dry space with uniform temperature to prevent condensation and per manufacturer's recommendations. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

PART 2 PRODUCTS

2.1 CANDIDATE MANUFACTURES/PRODUCTS

- A. Candidate manufacturers and models are listed below. To conform to specified requirements, the manufacturer's standard product may require modification.
 1. Asco 7000 Series
 2. Approved Equal

2.2 AUTOMATIC TRANSFER SWITCH

- A. Furnish and install where indicated a "programmed (delayed) transition" style, 3-pole (with solid neutral) automatic transfer switch with ratings, features, accessories, enclosures, etc. indicated on the drawings or noted herein.
- B. The transfer switch equipment as specified herein shall be 100% equipment rated for continuous duty at the ratings shown on the plans and shall conform to the applicable

requirements for UL 1008 for emergency total system load. All transfer switch equipment supplied shall bear the UL label.

- C. All main power contacts shall be rated for multiple fault interruptions per UL 489, and/or UL 1087. Main contacts shall have independent “break-before-make” transfer action which shall positively prevent dangerous “source-to-source” connections.
- D. Automatic transfer switches specified herein shall consist of completely enclosed contact assemblies and a separately mounted control logic panel. Control power for all automatic transfer operations shall be derived from the line side of the source to which the load is being transferred.
- E. Upon loss of phase-to-phase voltage of the normal power source on any phase to 70% of nominal, and after a time delay of 0-5 seconds (adjustable to meet conditions present) to override momentary dips and/or outages, starting of the emergency/standby power source shall be initiated. Transfer to the emergency standby power source shall take place 2-60 seconds (adjustable) after attainment of 90% of rated voltage and frequency of that source.
- F. When the normal power source has been restored to 90% of rated voltage and after a time delay adjustable from 0-30 minutes (to insure the integrity of the normal power source), the load shall be retransferred to the normal source.
- G. A time delay, adjustable 0-10 minutes, shall delay shutdown of the emergency/standby power source after retransfer to allow the generator to run unloaded for cool-down, after which the generator shall be automatically shut down.
- H. If the emergency/standby power source should fail while carrying the load, transfer to the normal power source shall be made instantaneously upon restoration of the normal source to satisfactory conditions.
- I. The following features/accessories shall be provided:
 - 1. Auto/test switch to provide test operation of the automatic transfer switch by simulating a loss of the normal power source.
 - 2. Pilot lights to indicate to which source the load is connected.
 - 3. Pilot lights to indicate that an integral overcurrent protective device has tripped.
 - 4. Plant exerciser timer providing automatic test operation of the emergency/standby power source at pre-selected intervals at least once per week, including a selector switch to select exercise with or without load or a bypass of the exercise period. The clock timer shall be provided with a digital readout and include a lithium battery backup to assure continuity of power to the clock timer for a minimum of 72 hours during an outage.

5. Provide “dry”, form C contacts for the following conditions, as a minimum. Contacts shall be rated 10 Amps at 120 VAC:
 - a. ATS in “Normal” position
 - b. ATS in “Generator” position
 - c. “Normal” power source available
 - d. ATS failure (common failure alarm)

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 26 05 00 and Install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Automatic Transfer Switches shall be installed, configured and tested on site in accordance with the requirements of Section 26 05 00 and in accordance with the manufacturer’s recommendations. Field Setup shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. CONTRACTOR shall provide the services of the manufacturer’s representative for a minimum of one day for the calibration and testing of the equipment after certification of proper installation.

3.2 DAMP AND WET LOCATIONS

- D. Unless otherwise specified, all electrical enclosures in damp and wet locations shall be NEMA 4, stainless steel.
- E. All conduit entries into equipment located in damp or wet locations shall be through the bottom or lower sides of enclosures. Top entry of conduits will not be allowed.

3.3 TESTING

- A. Service Equipment shall be tested for proper operation and function in accordance with Section 26 08 00.
- B. Coordinate with Generator supplier to provide an integrated test to demonstrate ATS senses loss of utility power, starts the generator, verifies the electrical output from the generator is valid and transfer the load to the standby power source.

Verify also that restoring Utility power is sensed appropriately by the ATS and that after the selected time delay, restores utility power to the generator. Verify proper generator cool down run time is provided for either in the generator or in ATS settings.

- C. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.
- D. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

END OF SECTION

SECTION 26 43 13

SURGE PROTECTIVE DEVICES FOR LOW- VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Definitions.
 - 5. Submittals.
 - 6. Products.
 - 7. Execution.

1.2 SCOPE

- A. 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 (MCC).
- B. Provide a transient voltage suppression system that is suitable for application in IEEE C62.41 Category A, B and C3 environments, as tested by IEEE C2.11, C62.45.

1.3 REFERENCE STANDARDS

- A. Provide SPD unit designed, manufactured, tested and installed in compliance with the following codes and standards:
 - 1. IEEE C62.41, C62.43, C62.45, C62.48, C62.62 Institute of Electrical and Electronic Engineers
 - 2. NEMA LS-1 National Electrical Manufacturer Association
 - 3. NFPA 20, 75 and 780 National Fire Protection Association
 - 4. NFPA 70 National Electric Code
 - 5. UL 1449 4th Edition or later, UL 1283 5th Edition or later and UL 96A Underwriters Laboratories

6. IEC 801 International Electrotechnical Commission

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 26 05 00 General Requirements for Electrical Work.
- B. Furnish a manufacturer's full 5-year parts and labor warranty from date of shipment against any part failure when installed in compliance with manufacturer's written instructions, UL Listing requirements, and any applicable national, state, or local electrical codes.

1.5 DEFINITIONS

- A. TVSS - Transient Voltage Surge Suppression.
- B. SAD - Silicon Avalanche Diode.
- C. MOV - Metal Oxide Varistor.
- D. SPD - Surge protective device.

1.6 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements,

with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 4. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 5. Submit independent test data from a nationally recognized testing laboratory verifying the following:
 - a. Lifecycle testing
 - b. Overcurrent protection
 - c. UL 1449 4th Edition or later.
 - d. Surge current capacity.
- C. Shop Drawings:
1. Provide electrical and mechanical drawings by the manufacturer that detail:
 - a. Unit dimensions.
 - b. Weights.
 - c. Components
 - d. Field connection locations.
 - e. Mounting provisions.
 - f. Connection details.
 - g. Wiring diagram.
- D. Operation and Maintenance Manuals:
1. Provide the manufacturer's manual with installation, start-up, spare parts lists, and operating instructions for the specified system.

1.7 COORDINATION

- A. Coordinate with and provide SPD equipment to the electrical equipment manufacturer before final assembly and factory testing.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. One of the following or equal:

1. Liebert.
2. Eaton/Cutler Hammer.
3. Square D.
4. General Electric.

2.2 MANUFACTURED UNITS

A. Electrical Requirements

1. SPD ratings shall be consistent with the nominal system operating voltage, phase, and configuration.
2. Maximum Continuous Operating Voltage (MCOV):
 - a. The MCOV shall not be less than 115% of the nominal system operating voltage.
3. 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.
4. Unit shall operate without the need for an external overcurrent protection device (OCPD) and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
5. Operating Frequency:
 - a. 47 to 63 hertz.
6. 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.

B. Protection Modes:

1. Provide SPD protection modes as follows:
 - a. Line to Neutral (L-N).
 - b. Line to Ground (L-G).

- c. Neutral to Ground (N-G).
 - d. Line to Line (L-L).
- C. ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

	Nominal Voltage	Configuration	L-N (Volts)	N-G (Volts)	L-G (Volts)	L-L (Volts)
Wye Models	120/208	Grounded Wye	700	700	700	1200
	277/480	Grounded Wye	1200	1200	1200	2000
	347/600	Grounded Wye	1500	1500	1500	3000

- D. Environmental Requirements:
1. Storage Temperature:
 - a. -40 degrees to +60 degrees Celsius.
 2. Operating Temperature:
 - a. 20 degrees to +60 Celsius.
 3. Relative Humidity:
 - a. 5 percent to 95 percent.
 4. Audible Noise:
 - a. Less than 45 dBa at 5 feet (1.5 m).
 5. Operating Altitude:
 - a. Zero to 12,000 feet above sea level.
- E. Enclosure:
1. Located in electrical equipment where indicated on the Drawings.
- F. Internal Connections:
1. Provide low impedance copper plates for intra-unit connections:
 - a. Attach surge modules using bolted connections to the plates for low impedance connections.
 2. Size all connections, conductors, and terminals for the specified surge current capacity.

2.3 COMPONENTS

- 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 to meet this specification shall not be accepted.
 - 1. Type 2 units with filtering shall conform to UL 1283 5th Edition.
 - 2. Type 1 units shall not contain filtering or have a UL 1283 5th 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. Thermal MOV Protection
 - 1. 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.
- F. 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.
- G. Safety Requirements
 - 1. 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.

2. 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.

2.4 SYSTEM APPLICATION

- A. 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.
- B. 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

2.5 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

- A. 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.
 1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.
 2. 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.
 3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. 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, in the case a disconnect is required.
5. The SPD shall be included and mounted within the panelboard by the manufacturer of the panelboard.
6. The SPD shall be of the same manufacturer as the panelboard.
7. The complete panelboard including the SPD shall be UL67 listed.

2.6 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 factory installed integral to the switchgear, switchboard, MCC, and/or bus plug at the assembly plant by the original equipment manufacturer.
- D. 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.
- E. 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.
- F. The SPD shall be integral to switchgear, switchboard, MCC, and/or bus plug as a factory standardized design.
- G. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.7 SERVICE ENTRANCE REQUIREMENTS

- A. Service entrance located SPDs shall be tested and designed for applications within ANSI/IEEE C62.41 Category C environments.

2.8 ACCESSORIES

- A. Unit status indicators:
 1. Provide red and green solid-state indicators, with printed labels, on the hinged front cover to redundantly indicate on-line unit status:

- a. The absence of the green light and the presence of the red light indicates that surge protection is reduced and service is needed to restore full operation.
- B. Dry contacts for remote monitoring:
 - 1. Electrically isolated Form C dry contacts (10A/125VAC) for remote monitoring of system integrity, and indication of under voltage, phase and/or power loss.
- C. Provide on-line circuit, which tests and redundantly monitors individual components in all protection modes including neutral to ground:
 - 1. Units that require external test sets or equipment are unacceptable.
- D. Provide an integral disconnect switch located in-line with the SPD system enclosure:
 - 1. External manual operator.
 - 2. The switch shall disconnect all ungrounded circuit conductors from the SPD.
 - 3. The integral disconnect switch shall be capable of withstanding, without failure, the maximum published surge current magnitude and short circuit current without failure or damage to the switch.
- E. Interconnection Cable:
 - 1. Interconnect the SPD to the power system using a manufacturer furnished assembly of low impedance coaxial cables installed in flexible conduit.
 - 2. Cable designed to transmit transients with minimal voltage drop.
 - 3. UL listed.

2.9 SOURCE QUALITY CONTROL

- A. Permanently affix surge rating to the SPD.
- B. Test the system at the component and fully assembled level, under surge conditions with alternating current power applied for a minimum of 1 hour:
 - 1. Testing includes but not limited to:
 - a. Quality control checks.
 - b. Dielectric voltage withstand test per UL requirements.
 - c. UL ground continuity tests.
 - d. Operational and calibration tests.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Section 26 05 00.
- B. Special Techniques:
 1. Install the SPD with as short and straight conductors including ground conductor as practically possible.
 2. Twist the SPD input conductors together to reduce input conductor inductance.
 3. Follow the SPD manufacturer's recommended installation practices and comply with all applicable codes.
 4. Interconnect the SPD to the power system using a manufacturer supplied interconnection cable consisting of low impedance coaxial cables installed in a flexible conduit.
 5. Do not subject SPD to insulation resistance testing.

END OF SECTION

SECTION 26 50 00 - LUMINAIRES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
1. Scope.
 2. Quality Assurance.
 3. Submittals.
 4. Products
 5. Execution

1.2 SCOPE

- A. This section specifies luminaires (lighting fixtures) features and installation.

1.3 DEFINITION

- A. Lighting terminology used herein is defined in IES RP-16.

1.4 QUALITY ASSURANCE

A. REFERENCE STANDARDS

1. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NFPA 70	National Electrical Code (NEC)

- B. SPECIAL WARRANTY: In accordance with Section 01 10 00 provide a Special Warranty for LED luminaires. The Special Warranty shall include as a minimum the following:
1. A written 5-year on-site replacement material, fixture finish and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty must include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking or fading.
 2. A written 5-year replacement material warranty for defective or non-starting LED source assemblies.
 3. A written 5-year replacement material warranty on all power supply units (PSU).
 4. A written 5-year replacement warranty for luminaires producing inadequately maintained illuminance levels at the end of the warranty period, as prorated from levels expected at end of useful life.
 5. The warranty period shall begin on the date of Substantial Completion. The Contractor shall provide the Owner with appropriate signed warranty certificates. The Owner shall have received these certificates prior to final payment.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

- b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
 3. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 4. Catalog cuts shall be edited to show only the items, model numbers, and information which apply
 - a. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - b. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
 - c. Arrange in order of luminaire designation.
 - d. Include data on features, accessories, and finishes.
 - e. Include physical description and dimensions of luminaires.
 - f. Include emergency lighting units, including batteries and chargers.
 - g. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
 5. Photometric data and adjustment factors based on laboratory tests.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- C. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- D. Product Schedule: For luminaires and lamps.
1. Manufacturer's installation instructions

PART 2 PRODUCTS

2.1 GENERAL

- A. Unless otherwise specified, lighting materials, including fixtures, accessories, and hardware, shall conform to the requirements specified in the drawings. Lighting fixtures shall be provided where specified on the drawings. The drawing's light fixture placement is diagrammatical in nature. The actual installation and fixture layout shall be coordinated with the various trades and equipment.

2.2 LAMPS

- A. ACCEPTABLE PRODUCTS: Lamps shall be Dialight, General Electric, North American Philips (Norelco), Sylvania, Venture Lighting International, or approved equal.
- B. GENERAL:
1. Lamps shall be as specified on the Luminaire Schedule in the drawings.
- C. SPARES: Number of spares shall be equal to 5 percent of each rating type, with a minimum of one standard manufacturer's package.

2.3 EXTERIOR LIGHTING POLES ON STRUCTURE

- A. GENERAL: Provide lighting poles with the necessary fixture mounting hardware.
- B. TYPE: Poles shall be 2.5" diameter stainless steel with hand holes.
- C. Where Shown on the drawings, provide 1" X 10' Rigid Galvanized Steel Conduit to serve as mounting pole for fixtures attached to structure. Attached Conduit to Structure in a minimum of two places with approved anchorage method for wind load of the project area.

- D. Where shown on the drawings, poles to be provided with GFI, weatherproof receptacles located 24" above the base.

2.4 PHOTOELECTRIC CELL UNITS

- A. Where required, Photoelectric cell units shall consist of a cadmium sulfide cell housed in a plug receptacle assembly. The plug receptacle assembly shall be three-prong polarized locking type. Assembly shall be suitable for outdoor mounting and shall be rated for 1800 VA at 120V maximum capacity.

2.5 EMERGENCY LIGHTING

- A. In areas that show or require emergency lighting fixture in room that is also used for normal lighting, shall include LED luminaires as specified in this Section but with integrated 90 minute backup battery and test switch.

2.6 LED LUMINAIRES (LED)

- A. LED luminaires shall be a complete functioning unit with all components including light source, lamps, power supply, control interface and any additional components needed for operation shall be assembled by the luminaire manufacturer.
- B. Luminaires shall comply with ANSI chromaticity standard for classifications of color temperature. See the Luminaire Schedule in the drawings for specified LED lamp color and color temperature. Luminaire shall be UL or ETL listed and labeled.
- C. Luminaire testing shall be per IESNA LM-79 AND LM-80 procedures.
- D. Useful Life Requirements: The useful life of the luminaire in terms of lumen output must be specified by one of the following two methods:
 - 1. Simplified L70 threshold: A minimum of 50,000 operating hours before reaching the L70 lumen output degradation point, accounting for individual LED lumen depreciation and catastrophic failures. Fifty percent of the sample population must reach the 50,000 hour point—this is known as B50. Only 10 percent of the LED lamps can have failed in a conventional sense— this is known as F10.
- E. Provide shop drawings showing illumination levels with LED systems based on lumen output at 70 percent lumen depreciation for white LEDs and 50 percent for colored LEDs. Initial lumen output for all LEDs shall be listed individually.
- F. LED drivers shall have reversed polarity protection, open circuit protection and require no minimum load. Drivers shall operate at a minimum 80 percent efficiency and have a class-A noise rating.

- G. Where LED systems are required to be dimmable, the LED system shall be capable of full and continuous dimming.

PART 3 EXECUTION

3.1 GENERAL

- A. The location and type of fixtures are shown on the drawings. Lighting circuit raceways and conductors shall be sized by the contractor. Raceways and wire shall be provided from the fixtures and switches to the lighting panel in accordance with the NEC. Raceways shall be provided in accordance with Section 26 05 33. Wire shall be provided in accordance with Section 26 05 19.
- B. Fixtures labeled to require conductors with a temperature rating exceeding 75 degrees C shall be spliced to circuit conductors in a separately mounted junction box. Fixture shall be connected to junction box using flexible conduit with a temperature rating equal to that of the fixture.
- C. Photoelectric cells, where specified, shall be oriented toward the north.
- D. Labels and marks, except the UL label, shall be removed from exposed parts of the fixtures. Fixtures shall be cleaned when the project is ready for acceptance.
- E. Where recessed fixtures are required, the fixture shall be provided with mounting hardware for the ceiling system specified. Catalog numbers given on the Luminaire Schedule in the drawings shall not be used for selection of mounting hardware, but only as a reference to the type of fixture required. A concealed latch and hinge mechanism shall be provided to permit access to the lamps and ballasts and for removal and replacement of the diffuser without removing the fixture from ceiling panels. Fixtures recessed in concrete shall have protective coating of bituminous paint.
- F. Fixtures shall be aligned and directed to illuminate an area as specified. Fixtures shall be directly and rigidly mounted on their supporting structures. Unless otherwise specified, conduit system shall not be used to support fixtures. Where brackets or supports for lighting fixtures are welded to steel members, the welded area shall be treated with rust-resistant primer and finish paint.
- G. Underground and outdoor wire splices shall be in accordance with Section 26 05 19.

END OF SECTION

DIVISION 31 - EARTHWORK

**SECTION 31 05 13
SOILS FOR EARTHWORK**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes range of soil and subsoil materials intended to be referenced by other sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other sections and on Drawing notes.

- B. Section includes:
 - 1. Subsoil materials
 - 2. Topsoil materials

- C. Related Sections
 - 1. Section 31 05 16 - Aggregates for Earthwork
 - 2. Section 31 10 00 – Site Clearing
 - 3. Section 31 22 13 - Rough Grading
 - 4. Section 31 23 16 – Excavation
 - 5. Section 31 23 17 - Trenching
 - 6. Section 31 23 23 - Fill

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

- B. ASTM International (ASTM):
 - 1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 2. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

3. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials source.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Furnish materials of each type from same source throughout the Work.
- B. Soil Testing:
 1. Soil sampling and testing to be completed by an independent laboratory approved by the Engineer.
 2. Frequency of testing shall be determined by the Engineer.
 3. All soil testing shall be paid for by the Contractor.
- C. Compaction Tests:
 1. Maximum density at optimum moisture content determined by ASTM D1557 (AASHTO T180).
 2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Soil Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 SUBSOIL MATERIALS

- A. Subsoil Type S1, Select Native Material:
 1. Select earth obtained from on-site excavations approved for use by Engineer.
 2. Graded.
 3. Free of peat, humus, vegetative matter, organic matter, and rocks larger than 3-inches in diameter.

4. Processed as required to be placed in thickness as prescribed and at the optimum moisture content to obtain level of compaction required by these specifications.
- B. Subsoil Type S2, Imported Fill Material:
1. Imported earth approved for use by Engineer.
 2. Meeting the requirements of Subsoil Type S1.

2.2 TOPSOIL MATERIALS

- A. Topsoil Type TS1, Select Native Topsoil Material:
1. Top 6 - 12 inches of existing soil containing organic matter.
 2. Engineer decision shall be final as to determination of what material is topsoil quality.
 3. Graded.
 4. Free of roots, rocks larger than 1/2-inch subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.
- B. Topsoil Type TS2, Imported Topsoil Material:
1. Imported borrow.
 2. Friable loam.
 3. Reasonably free of roots, rocks larger than 1/2-inch, subsoil, debris, large weeds, and foreign matter.
 - a. Screening: Single screened.
 4. Acidity range (pH) of 5-1/2 to 7-1/2.
 5. Containing minimum of 4 percent and maximum of 25 percent inorganic matter.

2.3 SPOILS

- A. All excess material not suitable or not required for backfill and grading shall be hauled off site and disposed of at a location provided by the Contractor and approved by the Engineer.
- B. Make arrangements for disposal of the material at no additional cost to the Owner.

- C. Landfill permit to be obtained by the Contractor and provided to Engineer prior to commencement of disposal.

2.4 SOURCE QUALITY CONTROL

- A. Testing and Analysis of Subsoil Material: Perform in accordance with ASTM D1557 (AASHTO T180).
- B. When tests indicate materials do not meet specified requirements, change material, or vary compaction methods and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.
- C. Furnish materials of each type from same source throughout the Work.

PART 3 EXECUTION

3.1 EXCAVATION

- A. Excavate material of every nature and description to the lines and grades as indicated on the Drawings and/or as required for construction of facilities.
- B. Site within clearing limits shall be stripped of topsoil as required to obtain additional topsoil necessary to complete Work indicated in the Drawings or as specified.
- C. When practical, do not excavate wet topsoil.
- D. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.
- E. Remove excess excavated subsoil and topsoil not intended for reuse from Site.
- F. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from Site.

3.2 STOCKPILING

- A. Stockpile soils at locations shown in the Drawings or at locations as approved by Engineer for redistribution as specified.
 - 1. Site may not have sufficient area to stockpile excavated material that will be required for fill later in the Project. If additional stockpile area is required to complete the Project on schedule, arrange off-site stockpile areas.
 - 2. No additional payments will be made for stockpiling excavated materials off-site.
- B. Stockpile in sufficient quantities to meet Project schedule and requirements.

- C. Separate differing materials with dividers or stockpile apart to prevent mixing.
- D. Prevent intermixing of soil types or contamination.
- E. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.
 - 2. Cover stockpiles to minimize the infiltration of water.
- F. Stockpile unsuitable and/or hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

SECTION 31 05 16
AGGREGATES FOR EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes a range of coarse and fine aggregate materials intended to be referenced by other Sections, generally for fill and grading purposes. Materials are indicated by "Type" to assist in referencing from other Sections and in Drawing notes.
- B. Section Includes:
 - 1. Coarse aggregate materials
 - 2. Fine aggregate materials
- C. Related Sections
 - 1. Section 31 05 13 - Soils for Earthwork
 - 2. Section 31 22 13 - Rough Grading
 - 3. Section 31 23 17 - Trenching
 - 4. Section 31 23 19 - Dewatering
 - 5. Section 31 23 23 - Fill
 - 6. Section 32 11 23 - Aggregate Base Courses
 - 7. Section 33 11 10 – Water Utility Distribution and Transmission Piping
 - 8. Section 33 41 10 - Storm Utility Drainage Piping

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO M147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base and Surface Courses
 - 2. AASHTO T27 - Sieve Analysis of Fine and Coarse Aggregates
 - 3. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

4. AASHTO TP61 - Standard Method of Test for Determining the Percentage of Fracture in Coarse Aggregate
- B. ASTM International (ASTM):
1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
 4. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
 5. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Materials Source: Submit name of imported materials suppliers.
- C. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
- D. Results of aggregate sieve analysis and standard proctor tests for all granular material.

1.4 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.
- B. Aggregate Testing:
 1. Aggregate sampling and testing to be completed by an independent laboratory approved by the Engineer.
 2. The frequency of testing shall be determined by the Engineer.
 3. All aggregate testing shall be paid for by the Contractor.
- C. Compaction Tests:
 1. Maximum density at optimum moisture content determined by ASTM D1557 (AASHTO T180).

2. In-place density in accordance with Nuclear Testing Method, ASTM D6938.
- D. Aggregate Classification: All imported materials shall be classified in accordance with ASTM D2487.

PART 2 PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

- A. Comply with the City of Port Orchard Public Works Engineering Standards and Specifications.
- B. Coarse Aggregate Type A1, Crushed Surfacing: Crushed surfacing top course and base course as shown in the Drawings shall meet the requirements of Section 9-03.9(3) of the WSDOT Standard Specification.
- C. Coarse Aggregate Type A2, Gravel Backfill for Pipe Zone Bedding: Crushed or uncrushed rock or gravel as shown in the Drawings shall meet the requirements of Section 9-03.12(3) of the WSDOT Standard Specification.
- D. Coarse Aggregate Type A3, Bank Run Gravel for Trench Backfill: Crushed or uncrushed rock or gravel as shown in the Drawings shall meet the requirements of Section 9-03.19 of the WSDOT Standard Specification. Coarse Aggregate Type A3 to be used for Granular Fill.
- E. Coarse Aggregate Type A4, Gravel Borrow: Gravel as shown in the Drawings shall meet the requirements of Section 9-03.14(1) of the WSDOT Standard Specification.
- F. Coarse Aggregate Type A5, Aggregate for Gravel Base: Gravel as shown in the Drawings shall meet the requirements of Section 9-03.10 of the WSDOT Standard Specification.
- G. Coarse Aggregate Type A6, Gravel Backfill for Walls: Gravel as shown in the Drawings shall meet the requirements of Section 9-03.12(2) of the WSDOT Standard Specification. Coarse Aggregate Type 6 to be used for Structural Fill.
- H. Coarse Aggregate Type A7, Gravel Backfill for Drains: Gravel as shown in the Drawings shall meet the requirements of Section 9-03.12(4) of the WSDOT Standard Specification.
- I. Recycled Aggregates:

Use of recycled concrete for crushed surfacing base course (1 1/4" minus) material is encouraged, provided that it is not used as a final surface finish. Recycled concrete shall meet the requirements for crushed surfacing base course material set forth in Section 9-03.9(3) of the Standard Specifications. Manufacturers recovering concrete from

sources other than concrete roadways, sidewalks, and slabs shall provide certification that the material supplied is free of contaminants.

Use of recycled concrete for crushed surfacing top course material (3/4" minus) is not allowed.

2.2 SAND

- A. Sand: Sand material shall consist of granular material, naturally produced, or produced from crushed gravel, or dredge sand that is reasonably free of organic material, mica, clay, fly ash, and other deleterious material, meeting the City of Port Orchard Public Works Engineering Standards and Specifications.

2.3 SOURCE QUALITY CONTROL

- A. Coarse Aggregate Material - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D1557 (AASHTO T180).
- B. Sand - Testing and Analysis: Perform in accordance with ASTM C136 and ASTM D1557 (AASHTO T180).
- C. When tests indicate materials do not meet specified requirements, change material and retest. Additional testing shall be completed and paid for by the Contractor with no reimbursement by the Owner.

PART 3 EXECUTION

3.1 STOCKPILING

- A. Stockpile materials imported to site as shown in the Drawings or at locations as approved by Engineer for redistribution as specified.
- B. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.
- C. Prevent intermixing of aggregate types or contamination.
- D. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.
 - 1. Grade surface of stockpiles to prevent ponding of water.
 - 2. Cover stockpiles to minimize the infiltration of water.

3.2 STOCKPILE CLEANUP

- A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.
- B. When borrow area is indicated, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION

**SECTION 31 10 00
SITE CLEARING**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes clearing site of incidental paving and curbs, debris, grass, trees, and other plant life in preparation for site or building excavation work.
- B. Related Sections:
 - 1. Section 01 56 39 – Temporary Tree and Plant Protection
 - 2. Section 02 41 00 - Demolition
 - 3. Section 31 22 13 - Rough Grading

1.2 DEFINITIONS

- A. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.
- B. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2-inch caliper to a depth of 12 inches below subgrade.
- C. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.
- D. Limits of Disturbance: Work area boundary as shown on the Plans.
- E. Root Wad: Tree stump and root mass including all roots greater than 1-inch diameter.
- F. Stripping: Removal of topsoil remaining after applicable scalping is completed.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Clearing, Grubbing, and Stripping Plan: Drawings clearly showing proposed limits to clearing, grubbing, and stripping activities at Site.
- C. Certification or disposal permit for landfill and/or waste disposal site.
- D. A copy of written permission of private property owners, with copy of fill permit for said private property, as may be required for disposal of materials.

1.4 QUALITY ASSURANCE

- A. Existing Conditions: Determine the extent of Work required and limitations before proceeding with Work.
- B. Obtain Engineer's approval of staked clearing, grubbing, and stripping limits prior to commencing clearing, grubbing, and stripping.
- C. Conform to applicable local, state, and federal codes for environmental requirements and disposal of debris,
 - 1. Burning on Project Site will not be permitted.
 - 2. Use of herbicides will not be permitted.
- D. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the Work described in this Section.
- E. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of laborers, other persons, and property in the vicinity of the work and requirements of the General Provisions.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Existing Materials: All materials, equipment, miscellaneous items, and debris involved, occurring or resulting from demolition, clearing, and grubbing work shall become the property of the Contractor at the place of origin, except as otherwise indicated in the Drawings or specifications.
- B. Wound Paint: Emulsified asphalt formulated for use on damaged plant tissues.

PART 3 EXECUTION

3.1 GENERAL

- A. Clear, grub, and strip areas needed for waste disposal, borrow, or Site improvements within limits shown in approved Clearing, Grubbing, and Stripping Plan.
- B. Remain within the property lines at all times.
- C. Do not injure or deface vegetation or structures that are not designated for removal.

3.2 EXAMINATION

- A. Verify existing plant life designated to remain is tagged or identified.
- B. Identify waste and salvage areas for placing removed materials.

3.3 PREPARATION

- A. Carefully coordinate the work of this Section with all other work and construction.
- B. Call Local Utility Line Information service at 1-800-424-5555, not less than three working days before performing Work.
- C. Request underground utilities to be located and marked within and surrounding construction areas.
 - 1. Disconnect or arrange for disconnection of utilities (if any) affected by required work.
 - 2. Keep all active utilities intact and in continuous operations.
- D. Prepare Site only after:
 - 1. Erosion and sediment controls are in place.
 - a. Limit areas exposed uncontrolled to erosion during installation of temporary erosion and sediment controls and in compliance with City of Port Orchard Erosion and Sediment Control Manual and Permits.
 - 2. Tree and vegetation protection is installed.
 - a. Protect existing site improvements, trees, and shrubs to remain to preclude damage during construction.
 - b. Follow the provisions set forth in 01 56 39, Temporary Tree and Plant Protection for all temporary tree and plant protection measures.
 - 3. Temporary fencing is installed along the Limits of Disturbance.
 - 4. Notification of utility agencies; disconnect or arrange for disconnection of utilities (if any) affected by required work. Keep all active utilities intact and in continuous operation.

3.4 PROTECTION

- A. Utilities: Locate, identify, and protect utilities located by utilities and indicated in the Drawings to remain from damage.

- B. Survey control: Protect benchmarks, survey control points, and existing structures from damage or displacement.
- C. Preservation and Trimming of Trees, Shrubs, and Other Vegetation:
 - 1. Avoid injury to trees, shrubs, vines, plants, grasses, and other vegetation growing outside of the areas to be cleared and grubbed and those trees and shrubs designated to be preserved.
 - 2. Protect existing trees and shrubs against cutting, breaking, or skinning of roots, skinning and bruising of bark, smothering of roots by stockpiling construction materials, excavated materials, excess foot or vehicular traffic, and parking of vehicles within drip line.
 - 3. Provide temporary guards, as necessary, to protect trees and vegetation to be left standing.
 - 4. Temporarily cover exposed roots with wet burlap to prevent roots from drying out, cover with earth as soon as possible.
 - 5. Provide protection for roots and limbs over 1-1/2-inch diameter cut during construction operations. Coat cut faces with emulsified asphalt.
 - 6. Repairable damage to trees and shrubs designated to remain shall be made by a professional tree surgeon approved by the Engineer. Cost shall be borne by the Contractor.
- D. Landscaped Areas:
 - 1. When any portion of the Work crosses private property or landscaped areas, excavate topsoil separately and pile it on the opposite side of the trench from the subsoil.
 - 2. Conduct Work in a manner that will restore original conditions as nearly as practicable.
 - 3. Remove and replace any trees, shrubs, plants, sod, or other vegetative material as needed to complete Work.
 - 4. All shrubs or plants shall be balled by experienced workers, carefully handled and watered, and replaced in their original positions without damage. Sod shall be handled in a similar manner.
 - 5. Wherever sod cannot be saved and restored, the ground must be reseeded and cared for until a stand of grass is reestablished.

6. Plants or shrubs killed or destroyed shall be replaced and paid for by the Contractor.
 7. It is the intent of this paragraph that the Contractor shall leave the surface and plantings in substantially the same conditions as before the Work is undertaken.
- E. Miscellaneous Site Features: Protect all existing miscellaneous site features from damage by excavating equipment and vehicular traffic, including but not limited to existing structures, fences, mailboxes, sidewalks, paving, and curbs.
- F. Repair and Replacement:
1. Damaged items, including but not restricted to those noted above, shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.
 2. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired at the Contractor's expense.

3.5 LIMITS

- A. As follows, but not to extend beyond Limits of Disturbance:
1. Excavation: 5 feet beyond top of cut slopes.
 2. Trench Excavation: 6 feet from trench centerline, regardless of actual trench width.
 3. Fill:
 - a. Clearing and Grubbing: 5 feet beyond toe of permanent fill.
 - b. Stripping: 2 feet beyond toe of permanent fill.
 4. Structures: 15 feet outside of new structures.
 5. Roadways: Clearing, grubbing, scalping, and stripping 5 feet from roadway shoulders.
 6. Other Areas: As shown.
- B. Remove rubbish, trash, and junk from entire area within the Limits of Disturbance as material is generated. Stockpiling shall not be permitted without written approval of Owner.

3.6 CLEARING AND GRUBBING

- A. Clear and grub areas within limits shown in approved Clearing, Grubbing, and Stripping Plan.
- B. Except in areas to be excavated, all holes resulting from the clearing and grubbing operations shall be backfilled and compacted in accordance with the applicable sections of these Specifications.
- C. Clearing:
 - 1. Remove trees, saplings, snags, stumps, shrubs, brush, vines, grasses, weeds, and other vegetative growth within the clearing limits shown in the Drawings, except those trees and shrubs noted to remain in the Drawings or as directed by the Engineer.
 - 2. Clearing shall be performed in such a manner as to remove all evidence of the presence of vegetative growth from the surface of the Project Site and shall be inclusive of sticks and branches of thickness or diameter greater than 3/8-inch and of grasses, weeds, exceeding 12 inches in height except as otherwise indicated.
 - 3. Clear undergrowth and deadwood, without disturbing subsoil.
- D. Grubbing: Clear areas required for access to site and execution of Work and remove all stumps, root wads, and roots over 1-inch diameter to the following depths:
 - 1. Future Structures and Building Areas 24 Inches
 - 2. Roads and Parking Areas 18 Inches
 - 3. All other Areas 12 Inches

3.7 TREE REMOVAL

- A. Exercise care in cutting, felling, trimming, and handling of those trees shown for removal to prevent damage to neighboring trees and structures to remain.
- B. Tree Protection: As shown on the Plans.
- C. Tree Removal: As shown on the Plans.
- D. No trees may be removed unless approved and permitted by the Engineer.
- E. Do not top trees unless otherwise specified or approved by Owner in writing.
- F. Refer to Section 01 56 39, Temporary Tree and Plant Protection for tree protection requirements.

3.8 REMOVAL AND DISPOSAL

- A. Native vegetation may be mulched and used on Site.
- B. Asphalt and Gravel Surfaces:
 - 1. Asphalt, concrete, and gravel surfaces designated for removal shall be done to full depth.
 - 2. Asphalt, concrete, and gravel removed at Site may be reused at Site where shown in the Drawings or following approval of the Engineer.
 - 3. Haul removed asphalt, concrete, and gravel which is unsuitable for reuse or that exceeds quantity required.
- C. Remove debris, rock, abandoned piping, and extracted plant life from Site.
- D. Remove from the Site all debris, materials, equipment, and items found thereon and materials and debris resulting from the Work, except as otherwise indicated.
 - 1. All existing improvements designated on the Drawings or specified to be removed including but not limited to structures, pipelines, walls, footings, foundations, slabs, pavements, curbs, fencing, and similar structures occurring above, at, or below existing ground surface shall be included in the Work.
 - 2. Unless otherwise specified, any resulting voids shall be thoroughly cracked out for drainage and backfilled with suitable excavated or imported material compacted to the density of the adjacent soil.
- E. Continuously clean-up and remove waste materials from site. Do not allow materials to accumulate on site.
- F. Do not burn or bury materials on site. Leave site in clean condition.
- G. Removal: All material resulting from demolition, clearing, and grubbing, and trimming operations shall be removed from the Site and disposed of in a lawful manner. Materials placed on property of private property owners shall be by written permission only.
- H. Cleanup: During and upon completion of work, promptly remove all unused tools and equipment, surplus materials, and debris.
- I. Adjacent areas shall be returned to their existing condition prior to the start of Work.

3.9 CLEANUP

- A. During the time Work is in progress, make every effort to maintain the Site in a neat and orderly condition.
- B. All refuse, broken pipe, excess fill material, cribbing, and debris shall be removed as soon as practicable.
- C. Should the Work not be maintained in a satisfactory condition, the Owner may cause the work to stop until the cleanup of the Work has been done to the satisfaction of the Engineer.
- D. The Work will not be considered complete, or the final payment certificate issued until all rubbish, unused material, or equipment shall have been removed and the premises left in a condition satisfactory to the Owner and the Engineer.

END OF SECTION

**SECTION 31 22 13
ROUGH GRADING**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes rough grading and filling associated with contouring of Site in preparation for building excavation and subsequent site work.

- B. Section Includes:
 - 1. Excavating topsoil
 - 2. Excavating subsoil
 - 3. Cutting, grading, filling, and rough contouring of Site

- C. Related Sections:
 - 1. Section 01 45 00 - Quality Control
 - 2. Section 31 05 13 - Soils for Earthwork
 - 3. Section 31 05 16 - Aggregates for Earthwork
 - 4. Section 31 10 00 - Site Clearing
 - 5. Section 31 23 16 - Excavation
 - 6. Section 31 23 17 - Trenching
 - 7. Section 31 23 23 - Fill

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

- B. ASTM International (ASTM):
 - 1. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
3. ASTM D2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate
4. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)
5. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
6. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Soils for Earthwork: As specified in Section 31 05 13, Soils for Earthwork.
- C. Aggregates for Earthwork: As specified in Section 31 05 16, Aggregates for Earthwork.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C136, ASTM D2419, and ASTM D2434.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Subsoil Fill: As specified in Section 31 05 13, Soils for Earthwork.
- B. Topsoil: As specified in Section 31 05 13, Soils for Earthwork.
- C. Structural Fill: As specified in Section 31 05 16, Aggregates for Earthwork.
- D. Granular Fill: As specified in Section 31 05 16, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify survey benchmark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

- A. Call Local Utility Line Information service at 1-800-424-5555 not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Notify Engineer of any potential conflicts resulting from utility locations and the Drawings.
 - 3. Notify utility company to remove and relocate utilities, as may be necessary.
- B. Identify required lines, levels, contours, and datum.
- C. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with the Work of this Section.

3.3 TOPSOIL EXCAVATION

- A. Excavate and stockpile topsoil as specified in Section 31 05 13, Soils for Earthwork.

3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, re-landscaped, or re-graded as shown in the Drawings.
- B. When practical, do not excavate wet subsoil. When wet subsoil must be excavated and is to be reused on site for the Work, process wet material to obtain optimum moisture content.
- C. Stockpile excavated material in area designated onsite in accordance with Section 31 05 13, Soils for Earthwork.
- D. When excavating through roots, perform Work by hand and cut roots with sharp axe.
- E. Benching Slopes: Horizontally bench existing slopes greater than 5H:1V to key placed fill material to slope to provide firm bearing.

F. Stability: Replace damaged or displaced subsoil as specified for fill.

3.5 FILLING

A. General:

1. Grading and filling operations shall not take place when weather conditions and moisture content of fill materials prevent the attainment of specified density.
2. Vertical curves or roundings at abrupt changes in slope shall be established as approved by Engineer.
3. Bring all graded areas to a relatively smooth, even grade and slope by blading or dragging. Remove high spots and fill depressions.

B. Fill areas to contours and elevations shown in the Drawings with unfrozen materials.

C. Topsoil Fill:

1. Scarify prepared subgrade to depth of 4 inches immediately prior to placing topsoil.
2. Place topsoil in areas to be seeded to depths indicated in the Drawings, minimum depth of 6 inches.
3. Place topsoil material loose; do not compact, do not place in wet or muddy conditions.

D. Place material in continuous layers as follows:

1. Subsoil Fill: Maximum 8 inches compacted depth.
2. Structural Fill: Maximum 12 inches compacted depth.
3. Granular Fill: Maximum 12 inches compacted depth.

E. Maintain optimum moisture content of fill materials to attain required compaction density.

F. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise.

G. Make grade changes gradual. Blend slope into level areas.

H. Repair or replace items indicated in the Drawings to remain which are damaged by excavation or filling. All costs shall be borne by the Contractor.

3.6 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus 1/10 of a foot from required elevation.

3.7 FIELD QUALITY CONTROL

- A. Perform laboratory material tests in accordance with AASHTO T180.
- B. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922
 - 2. Moisture Tests: ASTM D3017
- C. Frequency and location of testing is dependent upon type of material placed. See Section 01 45 00, Quality Control for testing requirements.
- D. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

END OF SECTION

SECTION 31 23 16 EXCAVATION

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes excavation required for building foundations, site structures, or under slabs-on-grade or paving. Excavating for utilities outside building is included in Section 31 23 17, Trenching.
- B. Section Includes:
 - 1. Excavating for building foundations
 - 2. Excavating for paving, roads, and parking areas
 - 3. Excavating for slabs-on-grade
 - 4. Excavating for site structures
 - 5. Excavating for landscaping
- C. Related Sections:
 - 1. Section 01 45 00 - Quality Control
 - 2. Section 02 41 00 - Demolition
 - 3. Section 31 05 13 - Soils for Earthwork
 - 4. Section 31 05 16 - Aggregates for Earthwork
 - 5. Section 31 10 00 - Site Clearing
 - 6. Section 31 22 13 - Rough Grading
 - 7. Section 31 23 17 - Trenching
 - 8. Section 31 23 19 - Dewatering
 - 9. Section 31 23 23 - Fill
 - 10. Section 31 50 00 - Excavation Support and Protection
 - 11. Section 33 11 10 - Water Utility Distribution and Transmission Piping.

1.2 DEFINITIONS

- A. Common Excavation: All excavation required for Work, regardless of the type, character, composition, or condition of the material encountered. Common Excavation shall further include all debris, junk, broken concrete, and all other material. All excavation shall be classified as Common Excavation, unless provided as Rock for under Section 31 23 18, Rock Removal below.
- B. Common Material: All soils, aggregate, debris, junk, broken concrete, and miscellaneous material encountered in Common Excavation, excluding rock as defined below.
- C. Concrete Excavation: The removal of pieces of concrete larger than 1 cubic yard in volume that requires drilling, splitting and breaking methods, or a necessitating a trench width increase of 18 inches or more than the width of the preceding 10 feet of trench. Concrete excavation includes materials composed of Portland cement that are not identified other than manholes, structures, sewer pipe, or other appurtenances.
- D. Exploratory Excavation: The removal and replacement of material from locations shown on the Drawings, or as directed for the purpose of investigating underground conditions and identifying potential utility conflict between existing and proposed utilities.
- E. Overbreak: Material beyond and outside of the slope limits established by the Owner's Representative, which becomes displaced or loosened during excavation and is excavated.
- F. Pothole Excavation: Pothole excavation is the removal and replacement of all materials via coring, vacuum extraction, or similar method, not classified as exploratory excavation, for the purposes of locating an underground utility and to investigate underground conditions.
- G. Rock Removal: As defined in Section 31 23 18, Rock Removal.
- H. Spoils: Excavated materials from Site unsuitable for use as fill or not required for backfill and grading.
- I. Unsuitable Materials: See Spoils.

1.3 REFERENCES

- A. Local utility standards when working within 24 inches of utility lines.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.

1.5 QUALITY ASSURANCE

- A. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.
- B. Provide adequate survey control to avoid unauthorized over-excavation.
- C. Weather Limitations:
 - 1. Material excavated when frozen or when air temperature is less than 32 degrees Fahrenheit (F) shall not be used as fill or backfill until material completely thaws.
 - 2. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

PART 2 PRODUCTS - Not Used

PART 3 EXECUTION

3.1 PREPARATION

- A. Prior to commencing work in this Section, become familiar with site conditions. In the event discrepancies are found, notify the Engineer as to the nature and extent of the differing conditions.
- B. Call Local Utility Line Information service at 1-800-424-5555 not less than 3 working days before performing Work.
 - 1. Request underground utilities to be located and marked within and surrounding construction areas.
 - 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.
- C. Identify required lines, levels, contours, and datum.
- D. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.

3.2 SITE CONDITIONS

- A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.
- B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.
- C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.

3.3 EXISTING UNDERGROUND UTILITIES

- A. Protect active utilities encountered, located or otherwise, and notify persons or agencies owning same.
- B. Remove inactive or abandoned utilities from within the project grading limits in accordance with Section 33 05 50, Existing Pipe Abandonment.
- C. For sewer and other miscellaneous drainage facilities, fill and plug pipes as follows:
 - 1. General:
 - a. Remove all structures to a minimum of 3 feet below subgrade, unless otherwise noted.
 - b. Cover top surface of all abandoned structures with two sheets of nonwoven geotextile, extended at least 1-foot beyond the outside walls of the abandoned manhole, sump, or basin.
 - c. Plug all abandoned pipes with permanent plugs as specified in Section 33 05 50, Existing Pipe Abandonment.
 - 2. Sumps:
 - a. Remove existing sediment, soil, and water. Properly dispose of these materials in accordance with the requirements of these specifications.
 - b. Remove top cone and first solid concrete section to a depth of approximately 8 to 10 feet below ground.
 - c. Fill sump with CLSM.

- d. Backfill remaining voids for facilities within existing or proposed roadways with approved materials meeting the requirements of Section 32 11 23, Aggregate Base Courses.
3. Salvaging Manhole Frames, Covers, and Grates:
- a. Remove manhole frames, covers, and grates scheduled for salvage and store in approved location.
 - b. Frames, grates, and covers meeting Specifications may be salvaged from structures to be adjusted and may be reused in the Work if of suitable size and condition.
 - c. Replace, at no additional cost to the Owner, all items damaged or lost by the Contractor with similar items that are comparable in all respects with those they are to replace, and which are adequate for the intended purpose.
 - d. Clean salvaged components to be reused of foreign material by methods that will not harm the components.
4. Existing Manhole Frames and Covers: Manhole frames and covers removed by the Contractor are the property of the Owner. Notify the Engineer a minimum of 48 hours before removal to arrange for pickup of the removed frames and covers, if not reused.

3.4 PRESERVATION OF EXISTING IMPROVEMENT

- A. Protect adjacent existing structures which may be damaged by excavation work.
- 1. Conduct operations in such a manner that existing street facilities, utilities, railroad tracks, structures, and other improvements, which are to remain in place, will not be damaged. Furnish and install cribbing and shoring or whatever means necessary to support material around existing facilities, or to support the facilities themselves, and maintain such supports until no longer needed.
 - 2. Open slopes shall not be cut within 5 feet of any existing spread footings unless approved by the Engineer.
 - 3. Do not interfere with 45 degree bearing splay of foundations unless approved by the Engineer
 - 4. Excavated material shall not be placed adjacent to existing or proposed structures.

3.5 EXCAVATION

- A. General:

1. Method of excavation shall be the Contractor's option, but care shall be exercised as final grade is approached to leave it in undisturbed condition.
 2. If the final grade for supporting structures is disturbed, it shall be restored to requirements of these Specifications and satisfaction of the Engineer at no additional cost to Owner.
 3. The Contractor is advised that footings should be poured as soon as possible to minimize unfavorable final grade conditions from developing.
 4. Provide all measures to ensure public safety.
- B. Control of Water:
1. Provide and maintain equipment to remove and dispose of water during the course of the work of this Section and keep excavations dry and free of frost or ice.
 2. Bearing surfaces that become softened by water or frost must be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.
 3. Grade top perimeter of excavation to prevent surface water from draining into excavation.
 4. See additional requirements in Section 31 23 19, Dewatering.
- C. Frozen Ground: Frost protection shall be provided for all structural excavation work. Foundation work shall not be placed on frozen ground.
- D. Excavate material of every nature and description to the lines and grades as indicated in the Drawings and/or as required for construction of the facility.
1. Allow for forms, shoring, working space, granular base, topsoil, and similar items, wherever applicable.
 2. Trim excavations to neat lines. Remove loose matter and lumped subsoil.
- E. Excavated Materials: Soils excavated at Site will be treated and used as one of two general categories of material as provided below.
1. Fill:
 - a. Subsoil Type S1, Select Native Fill, as approved for use by Engineer.
 2. Spoils:

- a. Ensure there is sufficient suitable material available to complete embankments and other required fillings prior to disposing of any excavated materials.
 - b. Make arrangements for disposal of spoils and include as part of contract work in preparing of project bids.
 - c. Landfill permit or written permission from private property owner to be obtained by the Contractor and provided to the Engineer.
- F. Shoring:
- 1. As specified in Section 31 50 00, Excavation Support and Protection.
- G. Slope existing banks with machine to angle of repose or less until shored.
- 1. Shape, trim, and finish cut slopes to conform to lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.
 - 2. Protection of excavation side slopes:
 - a. Use excavation methods that will not shatter or loosen excavation slopes.
 - b. Where practical, excavate materials without previous loosening and in limited layers or thickness to avoid breaking the material back of the established slope line.
 - c. Avoid overbreaks. Overbreak is incidental to the Work, except in cases where the Owner's Representative determines that such overbreak was unavoidable.
 - d. Excavation in rock or rocky cuts:
 - 1) Once completed, thoroughly test the slopes with bars or other approved means to remove all loose, detached, broken, or otherwise unstable material.
 - 2) Remove jutting points. Scale slopes using mine scaling rods or other approved methods to remove loose or overhanging materials and provide a safe, trim, neat, and stable condition.
 - 3) Dispose of the materials removed under this subparagraph in the same manner as other excavated material.
 - e. Remove all exposed roots, debris, and all stones more than 3 inches in size which are loose or could become loosened.
 - 3. Construct slopes free of all exposed roots.

4. Construct slopes free of unstable rock and loose stones exceeding 3 inches in diameter.
 5. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend off-site, outside of easements, outside of rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.
 6. Trim all surfaces neatly and smoothly.
- H. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with Section 31 23 17, Trenching and Section 31 23 23, Fill.
- I. Notify Engineer of unexpected subsurface conditions.
- J. Over-excavation for Unsuitable Foundation Conditions:
1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 2. Unsuitable materials encountered shall be removed and replaced with structural fill which conforms to Gravel Backfill for Walls as specified in Section 31 05 16, Aggregates for Earthwork and the City of Port Orchard Public Works Engineering Standards and Specifications. All material placed shall be compacted to 95 percent of maximum dry density.
 3. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.
- K. Rock Removal:
1. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section.
 2. Concrete removal, as defined herein, shall be treated as Rock Removal.
- L. Stockpile excavated material in area(s) designated on or off site in accordance with Section 31 05 13, Soils for Earthwork.

3.6 FIELD QUALITY CONTROL

- A. Perform excavation and controlled fill operations in accordance with the requirements of this Section.

- B. Coordinate the visual inspection and approval of all bearing surfaces by Engineer before installing subsequent work.

3.7 PROTECTION

- A. Prevent displacement or loose soil from falling into excavation; maintain soil stability and store excavated materials at a distance from top of excavation.
- B. Protect structures, utilities, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

**SECTION 31 23 17
TRENCHING**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the requirements for excavation and backfill of all utilities, including installation of pipe bedding, pipe zone backfill, trench backfill, and related Work as shown on the Drawings and as specified.

- B. Section includes:
 - 1. Excavating trenches for pipe, utility vaults, and other utilities.
 - 2. Compacted fill from top of utility bedding to final grades.
 - 3. Trench and utility vault backfilling and compaction.

- C. Related Sections:
 - 1. Section 01 45 00 - Quality Control
 - 2. Section 03 30 00 - Cast-In-Place Concrete
 - 3. Section 31 05 13 - Soils for Earthwork
 - 4. Section 31 05 16 - Aggregates for Earthwork
 - 5. Section 31 10 00 - Site Clearing
 - 6. Section 31 22 13 - Rough Grading
 - 7. Section 31 23 16 - Excavation
 - 8. Section 31 23 23 - Fill
 - 9. Section 31 23 24 - Flowable Fill
 - 10. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 11. Section 33 31 10 - Sanitary Utility Sewerage Piping: Sanitary sewer piping and bedding
 - 12. Section 33 41 10 - Storm Utility Drainage Piping

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):
 - 1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
 - 4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
 - 5. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.3 DEFINITIONS

- A. Controlled Low Strength Material (CLSM): Also referred to as Flowable Fill. Lean cement concrete fill. A self-compacting, cementitious material.
- B. Flexible Pipe: For the purposes of these Specifications, tubing between 1/2-inch and 4-inch diameter constructed of polyvinyl chloride (PVC) and high-density polyethylene (HDPE) are considered flexible pipes. HDPE piping 4 inches in diameter and larger is also considered flexible pipe.
- C. Geosynthetics: Geotextiles, geogrids, geomembranes, and drainage composite materials.
- D. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- E. Lift: Loose (uncompacted) layer of material.
- F. Obstructions: Items which may be encountered during utility and vault trenching which do not require replacement.
- G. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.
- H. Pipe Bedding: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 6 inches below the bottom outside surface of pipe, conduit, cable, or duct bank to the trench foundation so as to uniformly support the barrel of the pipe.
- I. Pipe Zone: Trench backfill zone for full trench width which extends from the bottom outside surface of the pipe to a minimum of 12 inches above the top outside surface of pipe, conduit, cable, or duct bank.
- J. Pipe Bedding, Pipe Zone, and Trench Backfill Classifications:
1. Class A: Backfill with suitable native or imported material that is approved to meet the characteristics required for the specific surface loading or other criteria of the backfill zone.
 2. Class B: Backfill with imported granular material consisting of gravel or crushed rock meeting the requirements of this Section and Coarse Aggregate Type A6 as specified in Section 31 05 16, Aggregates for Earthwork; typical designated size shall be 1-inch-0 or 3/4-inch-0.
 3. Class C: Backfill with Fine Sand, as specified in Section 31 05 16, Aggregates for Earthwork.
 4. Class D: Backfill with approved pit run or bar run material, well-graded from coarse to fine; maximum dimension shall be 3 inches.
 5. Class E: Backfill with CLSM. See Section 31 23 24, Flowable Fill.
- K. Pothole Excavations: Removal and replacement of all materials via coring, vacuum extraction, or similar method for the purposes of locating an underground utility and to investigate underground conditions.
- L. Prepared Trench Bottom: The bottom of the trench on which the pipe bedding is to lie, and which provides support for the pipe.
- M. Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM Standards.
- N. Rigid Pipe: For the purposes of these Specifications, pipe constructed of PVC, ductile iron, steel, concrete, and clay pipes are considered rigid pipes.

- O. Sewer, Pipes, and Mains: Conduits of circular or other geometric shapes, used to convey liquids or gases, or other material.
- P. Trench Backfill: Trench backfill zone for full trench width extending from the top of the pipe zone to pavement base rock, ground surface, or other surface material.
- Q. Trench Stabilization: Removal of unsuitable material in the bottom of a trench and replacement with specified material for support of a pipe, main, conduit, structure, or appurtenances.
- R. Utility: Any buried pipe, duct, conduit, or cable.
- S. Well-Graded: A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

1.4 SUBMITTALS

- A. Section 01 33 00, Submittal Procedures: Requirements for submittals.
- B. Excavation support plan and utility protection plan as specified in Section 31 50 00, Excavation Support and Protection.
- C. Product Data:
 - 1. Geotextile fabric, indicating fabric and construction
 - 2. Marking tapes
 - 3. Tracer wire
 - 4. Connectors for tracer wire and/or marking tapes
 - 5. Tracer wire locate boxes
 - 6. Marker balls
 - 7. Locator stations
 - 8. Ground wires
 - 9. Plastic or copper markers for service laterals.
- D. Imported Materials:
 - 1. Materials Source: Submit name and location of imported fill materials suppliers.

2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 3. Submit results of aggregate sieve analysis and standard proctor test for granular material.
- E. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.
- F. Concrete: Mix designs in accordance with Submittal requirements of Section 03 30 00, Cast-in-Place Concrete.

1.5 QUALITY ASSURANCE

- A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.
- B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.
- C. CLSM:
1. In-place testing: In accordance with ASTM C403.
 2. Compressive testing: In accordance with ASTM D4832.
- D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

1.6 COORDINATION

- A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.
- B. Coordinate trenching and utility installation work with other work at utility construction location occurring near or adjacent to specified herein.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: As specified in Section 31 05 13, Soils for Earthwork.
- B. Imported Granular Fill: Coarse Aggregate Type A5 as specified in Section 31 05 16, Aggregates for Earthwork.
- C. Concrete:

1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).
 2. Structural concrete as specified in Section 03 30 00, Cast-in-Place Concrete with compressive strength of 3,000 psi.
- D. Drain Rock: Coarse Aggregate Type A7, Gravel Backfill for Drains with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- E. Sand: As specified in Section 31 05 16, Aggregates for Earthwork.
- F. Trench Stabilization Material: Coarse Aggregate Type A6, Gravel Backfill for Walls, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

2.2 MARKING TAPE

- A. Detectable:
1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
 2. Foil Thickness: Minimum 0.35 mils.
 3. Laminate Thickness: Minimum 5 mils.
 4. Width: 6 inches.
 5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
 6. Joining Clips: Tin or nickel-coated furnished by Tape Manufacturer.
 7. Manufacturers and Products:
 - a. Reef Industries; Terra Tape, Sentry Line Detectable
 - b. Mutual Industries; Detectable Tape
 - c. Presco; Detectable Tape
- B. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities and as specified in NEMA Z535.1, Safety Color Code.

Color	Facility
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials

Color	Facility
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines

2.3 ELECTRONIC LOCATING MATERIALS

A. Tracer Wire:

1. Direct burial No. 12 AWG solid, annealed copper-clad steel (CCS) high strength tracer wire.
2. Tensile Breaking Load: 380-pound average.
3. Jacket:
 - a. High molecular weight high-density polyethylene complying with ASTM D1248, 30-volt rating.
 - b. Color: Provide in colors per Article 2.2.B above.
4. Manufacturer and Product: Copperhead Industries; LLC, 12 CCS high strength reinforced tracer wire, or equal.

B. Tracer Wire Connectors:

1. Waterproof, corrosion proof and suitable for No. 12 AWG solid core wire.
2. Prefilled with silicone and suitable for use with low-voltage tracer lines of less than 50 volts.
3. Lug Connectors:
 - a. Waterproof plastic housing that encases the silicone prefilled lug terminals.
 - b. Manufacturer and Product: King Innovations; DryConn™ Direct Bury Lug or equal.
4. Twist Connectors:
 - a. Waterproof epoxy-filled packaging that encases the silicone prefilled twist connectors.
 - b. Manufacturer and Product: 3M Division; DBY Direct Bury Splice Kit 09053 connectors or equal.

- C. Ground Wire: No. 12 AWG bare solid copper wire.
- D. Locator Station:
 - 1. Test Station:
 - a. Lexan® polycarbonate.
 - b. Color: Provide in colors per Article 2.03.B above.
 - 2. Terminals suitable for No. 12 AWG leads.
 - 3. Use single (two lead) locator stations with two terminals, one for ground wire and one for tracer wire, when only one tracer wire is terminated in manhole.
 - 4. Use multi-lead locator stations with the appropriate number of terminals when 2 or more tracer wire leads are terminated in manhole.
 - 5. Manufacturer and Product: Cott Manufacturing Company; FlangeFink® Cathodic Protection Test Station.

2.4 VISUAL IDENTIFICATION MATERIALS

- A. Tracer Wire Locate Boxes:
 - 1. Material: Polyolefin.
 - 2. Cover:
 - a. Color: Provide in colors per Article 2.03.B above.
 - b. Provide box cover identification marking for facility type such as “Sewer Locate Wire”, as approved by Owner.
 - c. Locking type with a nominal 6-inch opening.
 - 3. Manufacturer and Product: Carson Industries LLC; L Series Model 708 or equal.
- B. Service Lateral Plastic or Copper Markers:
 - 1. Service Lateral Plastic or Copper Markers: Use markers of the type that requires installation to be recessed below grade.
 - a. Material: Plastic or copper. In new concrete, use “new construction” markers; in existing concrete use “retrofit” markers and use adhesive recommended by the Manufacturer.

b. Plastic Pavement Markers:

- 1) UV stabilized and fade resistant.
- 2) Material: Meet or exceed a tensile strength of 3,500 psi, and meet test requirements as outlined in ASTM G53, Standard Practice for Light and Water Exposure of Nonmetallic Material.
- 3) Color: Provide in color per Article 2.2 B above with the words, "WARNING, BURIED [UTILITY TYPE], Call Before You Dig," molded to the top of marker.
 - a) Provide wording for specific facility as approved by Owner.
- 4) Manufacturer and Product: Rhino Marking and Protective Systems; A-TAG pavement markers or equal.

c. Copper Pavement Markers:

- 1) Material: Copper material chosen by Manufacturer.
- 2) Diameter: 1-5/32-inch.
- 3) Wording: Provide facility identification wording stamped on the top such as "Sewer Lateral" as approved by Owner.
- 4) Manufacturer and Product: Berntsen Concrete Marker; BP2-U or equal.

C. Service Lateral 2-inch by 4-inch Markers:

1. S4S Douglas fir, pressure-treated 2-inch by 4-inch lumber, utility grade or better.
2. Grade stamped by an American Lumber Standards certified inspection agency.

PART 3 EXECUTION

3.1 PREPARATION

- A. Call Local Utility Line Information service at 1-800-424-5555 not less than three working days before performing Work.
1. Request underground utilities to be located and marked within and surrounding construction areas.
 2. Coordinate with and notify utility companies should it be necessary to remove or relocate facilities.

3. Maintain and protect above and below grade utilities indicated to remain.
- B. Identify required lines, levels, contours, and datum locations.
 - C. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.
 - D. The site of an open cut excavation shall be first cleared of all obstructions preparatory to excavation in accordance with Section 31 10 00, Site Clearing.
 - E. See Section 31 10 00, Site Clearing for additional requirements in protection of existing utilities, survey control, plant life, and landscaped areas in coordination with Work in this Section.
 1. Intent of Drawings and Specifications is that all streets, structures, and utilities be left in condition equal to or better than original condition.
 2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material, which is satisfactory to Owner.
 - F. Potholing / Exploratory Test Pits: Dig such exploratory test pits and perform potholing as may be necessary in advance of trenching to determine the exact location and elevation of subsurface structures, pipelines, duct banks, conduits, and other obstructions which are likely to be encountered or need to be connected to and shall make acceptable provision for their protection, support, and maintenance of their continued operation.
 - G. Paved or Surfaced Streets:
 1. Wherever paved or surfaced streets are cut, saw wheel, or approved cutting devices shall be used.
 2. Width of pavement cut shall be as shown in the Drawings.
 3. Any cut or broken pavement shall be removed from site during excavation.
 - H. Traffic:
 1. Maintain street traffic at all times as required by the Drawings and as specified herein.
 2. Erect and maintain barricades, warning signs, traffic cones, and other safety devices during construction in accordance with the latest edition of Manual of Uniform Traffic Control Devices (MUTCD), Part 6, to protect the traveling public in any area applicable.

3. Provide flaggers as required during active work in roadway areas.
- I. Operations shall be confined to rights-of-way and easements provided. Avoid encroachment on, or damage to, private property or existing utilities unless prior arrangements have been made with copy of said arrangement submitted to Engineer.

3.2 EASEMENTS

- A. Where portions of the Work are located on private property, easements and permits will be obtained by the Owner. Easements shall provide for the use of property for construction purposes to the extent indicated on the easements.
- B. Copies of these easements and permits will be available from the Owner for inspection by the Contractor. It shall be the Contractor's responsibility to determine the adequacy of the easement obtained in every case.
- C. Confine construction operations to within the easement limits or street right-of-way limits or make special arrangements with the property owners for the additional area required and notify the Engineer with a copy of the written approval from property owners of any such conditions.
- D. Any damage to private property, either inside or outside the limits of right-of-way or easements provided by the Owner, resulting from Work shall be the responsibility of the Contractor. Before the Engineer will authorize final payment, the Contractor will be required to furnish the Owner with written releases from property owners where the Contractor has obtained special agreements or easements or where the Contractor's operations, for any reason, have not been kept within the construction right-of-way obtained by the Owner.

3.3 PROTECTION

- A. Existing Facilities:
 1. It is the intent of these specifications that all streets, structure, and utilities be left in a condition equal to or better than original condition at the completion of the Project.
 2. Where damage occurs, and cannot be repaired or replaced, the Contractor shall purchase and install new material to the satisfaction to the Engineer.
 3. Drawings and/or specifications cover and govern replacement and restoration of foreseeable damage.
- B. Removal of Water:
 1. As specified in Section 31 23 19, Dewatering.

2. At all times during construction provide and maintain ample means and devices with which to remove promptly and dispose of properly all water entering the excavations or other parts of the Work.
 3. Keep all excavations dry until the utilities or vaults to be placed therein are completed. In water bearing sand, well points and/or sheeting shall be supplied, together with pumps and other appurtenances of ample capacity to keep the excavation dry as specified.
 4. Dispose of water from the Work in a suitable legal manner without damage to adjacent property or structures.
- C. Trench Protection:
1. Provide the materials, labor, and equipment necessary to protect trenches at all times.
 2. Trench protection shall provide safe working conditions in the trench and protect the Work, existing property, utilities, pavement, etc.
 3. The method of protection shall be according to the Contractor's design.
 4. The Contractor may elect to use a combination of shoring, overbreak, tunneling, boring, sliding trench shields, or other methods of accomplishing the work provided the method meets the approval of all applicable local, state, and federal safety codes.
 5. Damages resulting from improper shoring, improper removal of shoring, or from failure to shore shall be the sole responsibility of the Contractor.

3.4 LINES AND GRADES

- A. Trench excavation for piping, utility vaults, and other utilities shall be performed to the alignment and grade as indicated in the Drawings.
- B. Where grades are not shown in the Drawings, utilities shall be laid to grade between control elevations shown.
- C. Water mains shall be installed with a minimum cover of 36 inches.
- D. The Engineer reserves right to make changes in lines, grades, and depths of utilities when changes are required for Project conditions.
- E. Changes in the grade and horizontal alignment of the pipeline as shown in the Drawings or as provided elsewhere in the Specifications may be necessary due to unanticipated interferences or other reasons.

1. No additional compensation will be allowed the Contractor for changes in horizontal alignment.
 2. No additional compensation will be allowed for changes in grade which require additional depth of trench excavation and backfill up to 2 feet from those shown in the Drawings.
- F. Use laser-beam instrument with qualified operator to establish lines and grades.

3.5 OBSTRUCTIONS

- A. Obstructions to the construction of the trench, such as tree roots, stumps, abandoned pilings, abandoned buildings and concrete structures, logs, rubbish, and debris of all types shall be removed without additional compensation from the Owner.
- B. The Engineer may, if requested by the Contractor or Owner, make changes in the trench alignment to avoid major obstructions if such alignment changes can be made within the perpetual easement and right-of-way and without adversely affecting the intended function of the facility or increasing costs to the Owner.

3.6 INTERFERING ROADWAYS AND STRUCTURES

- A. Remove, replace and/or repair any damage done during trenching activities to fences, buildings, cultivated fields, drainage crossings, and any other properties without additional compensation from the Owner.
1. Replace or repair these structures to a condition as good as or better than their pre-construction condition prior to commencing work in the area.
- B. Paved Roadways:
1. Where paved roadways are cut as part of trenching activities, Class D trench backfill will be required to the bottom of pavement base.
 2. New pavement shall be equal to or better than the existing paved surface.
 3. New surface shall not deviate by more than 1/4-inch from the existing finish elevation.
- C. Existing Structures:
1. If existing structures are encountered as part of trenching activities which will prevent construction and are not adequately shown in the Drawings, the Contractor shall notify the Engineer before continuing with the Work.

2. The Engineer may make such field revisions to the utility alignment as necessary to avoid conflict with the existing conditions.
3. The cost of waiting or “down time” during such field revisions shall be borne by the Contractor without additional cost to the Owner or liability to the Engineer.
4. If the Contractor fails to so notify the Engineer when a conflict of this nature is encountered, but proceeds with construction despite this interference, the Contractor shall do so at the Contractor’s own risk with no additional payment.

3.7 TRENCHING

- A. Excavate subsoil as required for construction of utilities to elevations shown in the Drawings.
- B. Remove boulders and rock up to 1/2 cubic yard measured by volume per the requirements of this Section. Remove larger boulders and rock material as specified in Section 31 23 18, Rock Removal.
- C. Open Trench Limit:
 1. Do not advance open trench beyond the distance which will be backfilled and compacted the same day.
 2. A maximum length of open trench shall not exceed 100 feet at any one time.
 3. Temporary resurfacing shall be completed within 300 feet of the associated open trench limit for each main pipe laying operation.
 4. Cover or backfill excavations at the end of each day.
 5. If the trench is not backfilled at the end of each working day:
 - a. Provide means to prevent caving of excavation sides, as necessary, during non-working hours.
 - b. Cover the excavation with a system as needed to provide public safety and prevention of entry during non-working hours.
 - c. Provide signed and stamped submittal of caving prevention system and cover system.
 6. New trenching shall not be started when earlier trenches need backfilling, or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- D. Utility Crossings: Avoid horizontal and vertical conflicts with existing utilities.

1. Perform excavation within 24 inches of existing utility service in accordance with utility's requirements.
 2. Vertical clearance between the new pipe and existing utilities shall be 12 inches minimum, unless otherwise noted on the Drawings.
 3. Where existing utility lines are damaged or broken during trenching activities, the utility shall be repaired or replaced. For water or sewer bearing lines, care being taken to insure a smooth flow line and absolutely no leakage at the new joints.
 4. All expenses involved in the repair or replacement of leaking or broken utility lines that have occurred due to the Contractor's operations shall be borne by the Contractor, and the amount thereof shall be absorbed in the unit prices of its bid.
- E. Water Lines Crossing Sewer Lines: Whenever water lines cross sewer lines, the Contractor shall comply with local Health Department requirements.
1. Wherever possible, the bottom of the water line shall be 18 inches or more above the top of sewer pipe. One full length of the water line pipe shall be centered at the crossing.
 2. For clearances less than 1-1/2 feet, the Contractor shall replace the existing sewer pipe with ductile iron or PVC of equal size, centered at the utility crossing, or shall encase existing sewer pipe with concrete for a minimum of 10 feet on both sides of crossing, as directed by the Engineer, at no additional cost to the Owner.
- F. Excavate trenches to width and depth as indicated on Drawings. No additional payment will be provided for trenching activities beyond dimensions shown in the Drawings.
1. Excavation for trenches in which pipelines are to be installed shall provide adequate space for workers to place and joint the pipe properly and safely, but in every case the trench shall be kept to a minimum width.
 2. The width of the pipe trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall not exceed 12 inches on either side of the pipe.
 3. Excavation for utility vaults and other structures shall be wide enough to provide 18 inches between the structure surface and the sides of the excavation.
 4. For pipe or utility vaults to have bedding material, excavate to a depth of 6 inches below the bottom of the pipe or utility vault. Care shall be taken not to excavate below depths required.
 5. If over digging occurs, the trench bottom shall be filled to grade with compacted bedding material.

- G. Remove water or materials that interfere with Work.
 - 1. The trench at all times shall be kept free from water to facilitate fine grading, the proper laying and joining of pipe, and prevention of damage to completed joints.
 - 2. Adequate pumping equipment shall be provided to handle and dispose of the water without damage to adjacent property.
 - 3. Water in the trench shall not be allowed to flow through the pipe while construction work is in progress unless special permission to do so has been given by the Engineer.
 - 4. An adequate screen shall be provided to prevent the entrance of objectionable material into the pipe.
 - 5. Remove and dispose of existing abandoned sewer pipe, structures, and other facilities as necessary to construct the improvements.
 - a. Where the excavation activities require the removal of portions of an abandoned pipeline, masonry plugs shall be installed in the open ends of the pipe, unless otherwise noted in the Drawings or by the Engineer.
 - b. Coordinate with Engineer prior to plugging.
 - c. For plugs less than 36 inches in diameter, 8-inch-deep masonry units shall be used. For plugs in larger pipelines, 12-inch-deep masonry units shall be used.
 - 6. The costs associated with the removal of water and materials noted above will be considered incidental to trench excavation and backfill.
- H. Do not interfere with 45 degree bearing splay of foundations.
- I. Over-excavation for Unsuitable Trench Foundation Conditions:
 - 1. Cross-sectional dimensions and depths of excavations shown in the Drawings shall be subject to such changes as may be found necessary by the Engineer to secure foundations free from soft, weathered, shattered, and loose material or other objectionable materials.
 - 2. Unsuitable materials shall be removed and replaced only as directed in writing by Engineer.
 - 3. Unsuitable materials encountered shall be removed and replaced with Coarse Aggregate Type A1, 2-1/2-inch – 0 gradation, as specified in Table 31 05 16-A of Section 31 05 16, Aggregates for Earthwork. All material placed shall be compacted to 95 percent of maximum dry density.

4. Install nonwoven geotextile under trench stabilization material, over the soft or yielding excavated surface.
 - a. Install the nonwoven geotextile ahead of placement of the trench stabilization material, continuously along the excavation bottom and centered on the pipe centerline.
 - b. Use nonwoven geotextile width equal to the pipe diameter plus 2 feet.
 - c. Place laps or splices in the geotextile in the direction of the pipe laying.
- J. Trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- K. Excavated material shall be placed at locations and in such a manner that it does not create a hazard to pedestrian or vehicular traffic or interfere with the function of existing drainage facilities or system operation.
- L. Remove excess subsoil not intended for reuse from site.
- M. Stockpile excavated material in area designated on site in accordance with Section 31 05 13, Soils for Earthwork.

3.8 TUNNELING

- A. In lieu of open cut trenching as specified above, the Contractor may utilize tunnel methods for installation of pipe where ground conditions are favorable and such methods will not disturb foundations under curbs, sidewalks, and other structures.
 1. The Engineer must approve tunneling methods prior to utility installation.
 2. Where tunneling is used, payment for the pipe installation will be made for the equivalent trench excavation and backfill as if the open cut method was used. Payment will not be made for surface restoration including pavement, curbs, sidewalks, and other surface improvements whose replacement is avoided by the tunneling method.

3.9 SHEETING AND SHORING

- A. See Section 31 50 00, Excavation Support and Protection.

3.10 COMPACTION

- A. Testing will be required to show specified densities of compacted backfill are being achieved by the Contractor's compaction methods.
- B. Moisture Control:

1. Moisture condition backfill material to within 2 percent of optimum moisture content required for compaction throughout each lift of the fill.
 2. Add moisture to granular backfill by sprinkling during compaction operation.
 3. Compaction by ponding or jetting is not permitted.
- C. Compact all materials and areas that are not accessible for in-place density testing, as determined by the Engineer, in place by whatever equipment and method is practicable or specified, and as approved by the Engineer.
1. Perform compaction at such moisture content as is required to produce well-filled, dense, and firm material in place that will show no appreciable deflection or reaction under the compacting equipment.

3.11 BEDDING

- A. All utility vaults, potable water pipe 4-inch nominal diameter and over, all steel pipe, all concrete sewer pipe, all plastic pipe, all pipe under existing or future structures or roadways, and any and all utilities at a depth greater than 6 feet shall be laid in pipe bedding material.
- B. Unless otherwise noted in the Drawings, pipe, or conduit of less than 4-inch diameter, outside structure lines and at a depth of less than 6 feet shall be bedded in native material properly shaped as specified below, all as detailed on the Drawings.
- C. Compacted bedding material shall be placed the full width of the excavated trench to a depth as shown on the trench detail included in the Drawings.
1. In lieu of a detail, the depth shall be 6 inches.
- D. Spread the bedding smoothly over entire width of trench to the proper grade so that the pipe is uniformly supported along the barrel.
- E. Hand grade and compact each lift to provide a firm, unyielding surface along the entire pipe length. For rigid pipe, compact to at least 90 percent relative compaction.
- F. Excavate bell holes at each joint to permit proper assembly and inspection of the joint.
- G. Check grade and correct irregularities in bedding material.
- H. Center pipes horizontally in trench width.

3.12 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen fill materials.

- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- C. Maintain optimum moisture content of fill materials to attain required compaction density.
- D. Place fill material, with the exception of CLSM, in continuous layers and compact in 6- to 8-inch lifts.
 - 1. Prevent pipe from moving either horizontally or vertically during placement and compaction of pipe zone material.
 - 2. Where trenches are under existing or future structures, paved areas, road shoulders, driveways, or sidewalks, or where designated on the Drawings or specified elsewhere in these specifications, the trench backfill shall be Class B or Class E and pipe zone backfill shall be Class B or Class E. Class B backfill shall be compacted to 95 percent of maximum density at optimum moisture content.
 - 3. Where trenches are outside existing or future structures, paved areas, road shoulders, driveways, or sidewalks, or where designated on plans or specified elsewhere, the trench backfill shall be Class A and pipe zone backfill in these areas shall be Class B. For these locations, compaction of Class B backfill shall be to not less than 90 percent of maximum density at optimum moisture content. Class B backfill shall be compacted to not less than 95 percent of maximum density at optimum moisture content.
- E. Employ placement method that does not disturb or damage nearby or adjacent foundation perimeter drainage or utilities in trench.
- F. Do not use power-driven impact compactors to compact pipe zone material.
- G. Backfill Immediately: All trenches and excavations shall be backfilled immediately after pipe or conduit is in approved condition to receive it and shall be carried to completion as rapidly as possible, unless otherwise directed by the Engineer.
- H. Under no circumstances shall water be permitted to rise in open trenches after pipe has been placed.
- I. Do not allow backfill material to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
- J. Use hand compactors for compaction until at least 2 feet of backfill is placed over top of pipe. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by “walking in” and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.

- K. Placement of Sand:
 - 1. Place medium sand in lifts not exceeding 8 inches in uncompacted thickness.
 - 2. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.
- L. Placement of CLSM:
 - 1. Discharge from truck-mounted drum-type mixer into trench.
 - 2. Place in lifts not exceeding 2 feet in thickness.
 - 3. No compaction of CLSM is allowed.
 - 4. Use steel plates to protect the CLSM from traffic a minimum of 24 hours. After 24 hours, the CLSM may be paved, or opened to traffic until permanent surface restoration is completed if it has hardened sufficiently to prevent rutting.
- M. New trenching shall not be started when earlier trenches need backfilling, or the surfaces of streets or other areas need to be restored to a safe and proper condition.
- N. Do not leave trench open at end of working day.

3.13 MARKING TAPE INSTALLATION

- A. Continuously install marking tape along centerline of all buried piping, install 24 inches below finished grade. Coordinate with piping installation drawings.

3.14 ELECTRONIC LOCATING FACILITY INSTALLATION

- A. Tracer Wire and Terminal Appurtenances:
 - 1. Tracer Wire:
 - a. Install as shown or directed directly over the pipe centerline and on top of the pipe zone in all sewer trenches, including mainline sewers, service laterals and storm sewer inlet leads.
 - b. Connect mainline and service lateral tracer wires using either an approved direct-bury lug connector or direct-bury twist connector.
 - c. Extend tracer wire to locator stations in manholes, locator boxes, storm inlets, or other visually identifiable terminal appurtenances, allowing for access with electronic locating equipment, as shown or directed and according to the following requirements:

2. Locator Stations:
 - a. Install locator stations as shown within manholes.
 - b. Mount locator station to manhole wall within 18 inches of manhole rim with two stainless steel expansion anchors.
 - c. Drill a minimum 3/8-inch diameter hole through the manhole wall within 18 inches of the finish grade of the manhole rim.
 - d. Extend the tracer wire from the pipe trench in one continuous piece up the outside of the manhole and through the hole and into a locator station and attach to one of the lugs in the locator station.
 - e. When multiple tracer wires are terminated in manhole install a multi-lead locator station.
 - f. Extend a ground wire from the locator station through a minimum 3/8-inch diameter hole in the manhole wall.
 - g. Install ground wire approximately 3 feet deep and extend from the outside manhole wall a minimum of 3 feet horizontally in any direction.
 - h. Seal all holes drilled in manhole walls with silicone sealant.
3. Storm Inlet Tracer Wire Termination: Terminate tracer wire inside inlet and directly over storm outlet pipe by placing tracer wire as follows:
 - a. Drill a minimum 3/8-inch diameter hole through inlet wall to pass tracer wire through to inside inlet wall.
 - b. Seal hole with silicon sealer or material approved by Engineer.
 - c. Leave 6 inches of coiled tracer wire along inside of inlet wall approximately 3 inches below the inlet frame and grate or as directed by Engineer.
4. Service Lateral Tracer Wire Termination: Terminate tracer wire at ends of service laterals as shown or directed, as follows:
 - a. Termination in Tracer Wire Locate Boxes: Extend the tracer wire in one continuous piece up vertically from the pipe trench and into the bottom of the locate box. Leave 18 inches of coiled tracer wire inside locate box.
 - b. Termination at 2-inch by 4-inch Markers: Extend tracer wire in one continuous piece directly up service lateral 2-inch by 4-inch markers and leave 18 inches of tracer wire wrapped around the exposed top end of 2-inch by 4-inch marker.

3.15 VISUAL IDENTIFICATION FACILITIES

- A. Tracer Wire Locate Boxes: Install tracer wire locate boxes directly over service laterals at property line, service boundary, or other location as shown or directed by the Engineer.

- B. Service Lateral Plastic or Copper Markers:
 - 1. Install plastic or copper markers in the concrete curb directly over the centerline of the service lateral, as shown or directed by the Engineer.
 - 2. Either plastic or copper markers may be used.
 - 3. If there is not suitable concrete curb for marker placement, then install a lateral cleanout as close to property line as practical at location approved by Engineer.

- C. Service Lateral 2-inch by 4-inch Markers:
 - 1. Place a 2-inch by 4-inch marker at the end of each new service lateral not connected to a building sewer.
 - 2. Omit markers only as approved.
 - 3. Block the capped or plugged service lateral end with a wood block against undisturbed earth and install the marker.
 - 4. Extend the marker from the blocked service lateral invert to at least 12 inches above the existing or proposed finish ground surface.
 - 5. Install marker in one piece. No splicing will be accepted.
 - 6. Paint the exposed portion of the marker after its installation with quality quick drying enamel white paint for a storm only sewer and green paint for a sanitary or combined sewer.
 - 7. After the paint has dried, use black, quick drying enamel, and neatly indicate the distance from the ground surface to the top of the service lateral in feet and inches.
 - 8. Do not disturb the position and location of the marker during the backfilling operation.
 - 9. If the marker is broken, moved out of location, or vertical alignment is changed during the backfilling operation, reopen the trench, and replace the marker.

3.16 FIELD QUALITY CONTROL

- A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Owner. Initial testing will be paid for by the Owner. Subsequent testing after failure of initial acceptance testing shall be paid by the Contractor.
- B. Perform laboratory material tests in accordance with ASTM D1557 (AASHTO T180).
- C. In-place compaction testing of pipeline backfill materials shall be performed at 2-foot elevation increments, one test per 500 lineal feet of pipeline trench as measured along pipe centerline.
 - 1. The Engineer may reduce the frequency when satisfied with method of compaction.
 - 2. The Engineer may direct testing at a higher frequency at no additional cost to the Owner upon failure to obtain specified densities or if the Contractor changes compaction equipment or methods of compaction.
 - 3. The Engineer shall determine all test locations.
- D. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922
 - 2. Moisture Tests: ASTM D3017
- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.

3.17 SURFACE RESTORATION AND CLEANUP

- A. Open Trenches: At the end of each workday, all open trenches shall be backfilled and all trenches within streets shall be temporarily paved or covered to the satisfaction of the Engineer and the local permitting agency.
 - 1. Temporary paving shall be replaced with permanent street paving at the completion of construction within street rights-of-way, or sooner, if deemed necessary by the Engineer.
 - 2. No gravel-filled trenches shall be left open within the street right-of-way at the end of the workday.
- B. Topsoil:

1. Where trenches cross lawns, garden areas, pastures, cultivated fields, or other areas on which reasonable topsoil conditions exist, remove the topsoil to the specified depth and place the material in a stockpile.
 2. Topsoil shall not be mixed with other excavated material.
 3. After the trench has been backfilled, the topsoil shall be replaced.
- C. Clean up and remove all excess materials, construction materials, debris from construction, etc. Replace or repair any fences, mailboxes, signs, landscaping, or other facilities removed or damaged during construction. Replace all lawns, topsoil, shrubbery, flowers, etc., damaged or removed during construction. The Contractor shall be responsible for seeing that lawns, shrubs, etc. remain alive and leave premises in condition equal to original condition before construction.

END OF SECTION

**SECTION 31 23 19
DEWATERING**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes temporary dewatering and surface water control systems for open excavations and utility trenches.
- B. Section includes:
 - 1. Dewatering systems.
 - 2. Surface water control systems.
 - 3. System operation and maintenance.
 - 4. Water disposal.
- C. Related Sections:
 - 1. Section 02 30 00 - Subsurface Investigations
 - 2. Section 31 05 16 - Aggregates for Earthwork
 - 3. Section 31 23 16 - Excavation
 - 4. Section 31 23 17 - Trenching

1.2 SUBMITTALS

- A. Dewatering Plan:
 - 1. Descriptions of proposed groundwater and surface water control facilities including, but not limited to, equipment; methods; standby equipment and power supply; pollution control facilities; discharge locations to be utilized; and provisions for immediate temporary water supply as required by this Section.
 - 2. Plan to be reviewed by the Engineer prior to the beginning of construction activities requiring dewatering. Review by the Engineer of the design shall not be construed as a detailed analysis of the adequacy of the dewatering system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.

1.3 DEFINITIONS

- A. Dewatering includes the following:
 - 1. Lowering of ground water table and intercepting horizontal water seepage to prevent ground water from entering excavations, trenches, tunnels, and /or shafts.
 - 2. Reducing piezometric pressure within strata to prevent failure or heaving of excavations, trenches, tunnels, and /or shafts.
 - 3. Disposing of removed water.
- B. Surface Water Control: Removal of surface water within open excavations.

1.4 QUALITY CONTROL

- A. All dewatering operations shall be adequate to assure the integrity of the finished project and shall be the responsibility of the Contractor.
- B. Provide all labor, materials, and equipment necessary to dewater trench and structure excavations, in accordance with the requirements of the Contract Documents.
- C. Secure all necessary permits to complete the requirements of this Section.
- D. Control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence.
- E. Where the critical structures or facilities 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.
 - 1. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the Contractor.
 - 2. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 EQUIPMENT

Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the jobsite.

PART 3 EXECUTION

3.1 DEWATERING

- A. Provide all equipment necessary for dewatering.
 - 1. Have on hand, at all times, sufficient pumping equipment and machinery in good working condition.
 - 2. Have available, at all times, competent workers for the operation of the pumping equipment.
 - 3. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.
- B. Dewatering for structures and pipelines shall commence when groundwater is first encountered and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- C. Site Grading:
 - 1. At all times, site grading shall promote drainage.
 - 2. Surface runoff shall be diverted from excavations.
 - 3. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- D. Dewatering shall at all times be conducted in such a manner as to preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation.
- E. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with drain rock.
- F. Maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- G. Flotation shall be prevented by maintaining a positive and continuous removal of water. The Contractor shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- H. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent

pumping of fine sands or silts from the subsurface. A continual check shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.

- I. Dispose of water from the work in a suitable manner without damage to the environment or adjacent property. No water shall be drained into work built or under construction without prior consent of the Engineer.
- J. All water discharges from dewatering work shall meet the stormwater quality standards of the State of Washington per WAC 173-201A-200. Turbidity shall not exceed 5 NTU over background NTU. The Contractor is responsible for using all means and equipment necessary to achieve these State standards. Water shall be filtered using an approved method to remove sand and fine sized soil particles before disposal into any drainage system.
- K. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- L. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the work and all costs thereof shall be included in the various contract prices in the bid forms.

END OF SECTION

SECTION 31 23 23
FILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes backfilling required at building perimeter and site structures to subgrade elevations, fill under interior and exterior slabs-on-grade or pavement, and fill under landscaped areas. Backfilling for utilities within building proper is included within this section; backfilling for utilities outside building is included in Section 31 23 17, Trenching.

- B. Section includes:
 - 1. Backfilling building perimeter to subgrade elevations.
 - 2. Backfilling site structures to subgrade elevations.
 - 3. Fill under slabs-on-grade.
 - 4. Fill under paving.
 - 5. Fill for over-excavation.

- C. Related Sections:
 - 1. Section 03 30 00 - Cast-In-Place Concrete
 - 2. Section 31 05 13 - Soils for Earthwork
 - 3. Section 31 05 16 - Aggregates for Earthwork
 - 4. Section 31 22 13 - Rough Grading
 - 5. Section 31 23 16 - Excavation
 - 6. Section 31 23 17 - Trenching
 - 7. Section 31 23 24 - Flowable Fill
 - 8. Section 31 25 00 - Erosion and Sediment Controls
 - 9. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 10. Section 33 31 13 – Public Sanitary Utility Sewerage Piping

11. Section 33 41 10 - Storm Utility Drainage Piping

1.2 REFERENCES

- A. American Association of State Highway and Transportation Officials:
 - 1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International (ASTM):
 - 1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
 - 2. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 - 3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
 - 4. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
 - 5. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

1.3 DEFINITIONS

- A. Controlled Density Fill (CDF): Also referred to as Low Strength Material (CLSM) in ASTM standards or Flowable Fill elsewhere in these Specifications. A self-compacted, cementitious material.
- B. Imported Material: Materials obtained from sources offsite, suitable for specified use.
- C. Lift: Loose (uncompacted) layer of material.
- D. Optimum Moisture Content:
 - 1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
 - 2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Imported Materials:
 - 1. Materials Source: Submit name and location of imported fill materials suppliers.
 - 2. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.
 - 3. Submit results of aggregate sieve analysis and standard proctor test for granular material.
- C. CDF: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.5 QUALITY ASSURANCE

- A. Subsoil and topsoil fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 13, Soils for Earthwork.
- B. Aggregate fill materials: In accordance with Quality Assurance requirements stated in Section 31 05 16, Aggregates for Earthwork.
- C. CDF:
 - 1. In-place testing: In accordance with ASTM C403.
 - 2. Compressive testing: In accordance with ASTM D4832.
- D. Allowable Tolerances: Final grades shall be plus or minus 0.1-foot.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Subsoil Fill: Type S2, Imported Fill Material, as specified in Section 31 05 13, Soils for Earthwork.
- B. Imported Granular Fill: Coarse Aggregate Type A6, Gravel Backfill for Walls with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- C. Concrete:
 - 1. Lean concrete as specified in Section 31 23 24, Flowable Fill, with compressive strength of 100 pounds per square inch (psi).

2. Structural concrete as specified in Section 03 30 00, Cast-in-Place Concrete. Compressive strength as required by the application or as noted in the Drawings.
- D. Drain Rock: Coarse Aggregate Type A7, Gravel Backfill for Drains Material with gradation as shown in the Drawings and specified in Section 31 05 16, Aggregates for Earthwork.
- E. Foundation Stabilization Material: Coarse Aggregate Type A6, Gravel Backfill for Walls, 2-1/2-inch - 0 gradation as specified in Section 31 05 16, Aggregates for Earthwork.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Prior to Work in this Section, become familiar with Site conditions. In the event discrepancies are found, notify Engineer as to the nature and extent of the differing conditions.
- B. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.
- C. Verify structural ability of unsupported walls to support loads imposed by fill.

3.2 SITE CONDITIONS

- A. Quantity Survey: The Contractor shall be responsible for calculations for quantities and volume of cut and fill from existing site grades to finish grades established under this contract as indicated in the Drawings or specified and shall include the cost for all earthwork in the total basic bid.
- B. Dust Control: Must meet all federal, state, and local requirements. Protect persons and property from damage and discomfort caused by dust. Water surfaces as necessary and when directed by Engineer to quell dust.
- C. Soil Control: Soil shall not be permitted to accumulate on surrounding streets or sidewalks nor to be washed into sewers.
- D. See provisions for Work in Section 31 25 00, Erosion and Sediment Controls.

3.3 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. Control of Water:
 1. Excavated areas shall be kept free of water and frost.

2. Bearing surfaces which become softened by water or frost shall be re-excavated to solid bearing at Contractor's expense and backfilled with compacted crushed rock at Contractor's expense.
 3. See Section 31 23 19, Dewatering for additional details.
- C. Compact subgrade to density requirements for subsequent backfill materials.
 - D. Cut out soft areas of subgrade not capable of compaction in place and replace with specified granular fill material. See Article 3.5, Over-excavation for Unsuitable Foundation Conditions in Section 31 23 16, Excavation for additional details.
 - E. Proof roll to identify soft spots; fill and compact to density equal to or greater than requirements for subsequent fill material.
 - F. Subgrade to be approved by Engineer prior to placement of structures and commencement of backfill activities.
 - G. Do not allow or cause any work performed or installed to be covered up or enclosed prior to required tests and approvals. Should any Work be enclosed or covered up, uncover at Contractor's expense.

3.4 BACKFILLING

- A. Backfill areas to contours and elevations shown in the Drawings with unfrozen materials.
- B. Do not place materials when weather conditions and/or moisture content prevent attainment of specified density.
- C. Maintain optimum moisture content of backfill materials to attain required compaction density.
- D. Employ placement method that does not disturb or damage other work.
- E. Mechanical tampers permitted in confined areas.
- F. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy subgrade surfaces.
- G. Foundation Base for Structures:
 1. Bring excavation to required subgrade elevation shown in the Drawings.
 2. Place foundation base material to required grade shown in the Drawings.

3. Place foundation base material in 6-inch lifts and compact to 95 percent maximum dry density.
 4. Pump Station:
 - a. Concrete Footings: Place a 6-inch minimum layer of Coarse Aggregate Type A6, Gravel Backfill for Walls, 3/4-inch-0 gradation to required grade under all concrete footings.
 - b. Concrete Slabs: Place an 8-inch minimum layer of Coarse Aggregate Type A6, Gravel Backfill for Walls, 3/4-inch-0 gradation under all concrete slabs.
 5. Foundations established near finished site grades:
 - a. Place a 3-inch-thick layer of Coarse Aggregate Type A1, Dense-Graded Aggregate, 3/4-inch-0 gradation in the bottom of footing excavations to minimize disturbance of silty foundation soils during wet weather.
 - b. Lightly compact material with a light-weight hand-operated vibratory plate compactor.
 - c. To provide uniform support, slabs should be underlain by a minimum 8-inch-thick granular base course consisting of 3/4-inch - 0 gradation.
 - d. The base course material should be installed in a single lift and compacted to at least 95 percent of the maximum dry density. See Drawings for details.
- H. Backfill for Structures:
1. Prior to placing backfill, remove forms, temporary construction, and debris below grade.
 2. Backfill shall not be placed against poured concrete until 28 days have passed from completion of original concrete pour, unless otherwise approved by Engineer.
 3. Heavy compactors and large pieces of construction equipment shall be kept away from any embedded wall a distance of at least 5 feet in order to avoid the build-up of excessive lateral pressures.
 - a. Over-compaction of fill near walls should be avoided.
 4. Compaction within 5 feet of the walls shall be accomplished using hand-operated vibratory plate compactors or tamping units.
 5. The maximum particle size of granular material placed against buried structures shall be limited to no greater than 1-1/2-inch diameter.

6. Structural fill backfill material shall be brought up on all sides of the walls and footings in such a manner as to avoid adverse differential lateral earth pressures on the vertical surfaces.
7. Appropriate lift thickness will depend on the type of compaction equipment used and the type of material being placed. All material shall be compacted to at least 95 percent of the standard maximum dry density.
 - a. For moderate- to heavy-weight compactors, a maximum loose lift thickness of 12 inches shall be used.
 - b. For hand-operated or small compactors, a maximum loose lift thickness of 8 inches shall be used.
8. Particular care must be taken to avoid damage to the pipe connections to the structure.
9. Utility trench backfill within 10 feet of all structural perimeters shall meet the requirements for structural fill.
- I. For areas receiving surface structures or existing paved areas to be constructed or replaced, such as roadways and driveways:
 1. Place Coarse Aggregate Type A6, Gravel Backfill for Walls, 3/4-inch-0 gradation in 6-inch lifts.
 2. Compact with vibratory equipment to 95 percent maximum density, unless otherwise specified or shown in the Drawings.
- J. Slope grade away from building minimum 2 percent slope for minimum distance of 10 feet, unless noted otherwise in the Drawings.
- K. Make gradual grade changes. Blend slope into level areas.
- L. Remove surplus backfill materials from Site in accordance with Section 31 23 16, Excavation.

3.5 FIELD QUALITY CONTROL

- A. All testing and reporting shall be conducted and completed by an independent laboratory provided by the Owner. Initial testing will be paid for by the Owner. Subsequent testing after failure of initial acceptance testing shall be paid by the Contractor.
- B. Perform laboratory material tests in accordance with ASTM D1557 AASHTO T180.

- C. In-place compaction testing for structural fill material shall be performed at 2-foot elevation increments in the fill material with at a minimum of one test per each 2,500 square feet of material placed. The Engineer shall be provided with the results of each compaction test at the time of testing.
- D. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D2922.
 - 2. Moisture Tests: ASTM D3017.
- E. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest at the sole expense of the Contractor.
- F. When testing of subgrade is not possible or feasible as detailed above, proof roll compacted fill surfaces under slabs-on-grade, pavers, paving, and as may be otherwise required by the Engineer.

3.6 PROTECTION OF FINISHED WORK

- A. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 31 23 24 - FLOWABLE FILL

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes flowable lean concrete mix used for structure backfill, utility bedding and backfill and other subgrade Site Work. Applications also include filling abandoned structures and utilities that remain in place.
- B. Section Includes:
 - 1. Structure backfill
 - 2. Utility bedding
 - 3. Utility backfill
 - 4. Filling abandoned utilities
- C. Related Sections:
 - 1. Section 33 11 50 - Existing Pipe Abandonment
 - 2. Section 31 23 16 - Excavation
 - 3. Section 31 23 17 - Trenching
 - 4. Section 31 23 23 - Fill
 - 5. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 6. Section 33 31 10 - Sanitary Utility Sewerage Piping
 - 7. Section 33 34 00 - Sanitary Utility Sewerage Force Mains
 - 8. Section 33 41 10 - Storm Utility Drainage Piping

1.2 DEFINITIONS

- A. Flowable Fill: Also referred to as Controlled Low Strength Material (CLSM) or Controlled Density Fill (CDF) elsewhere in the Specifications. Lean cement concrete fill.
- B. Utility: Any buried pipe, duct, conduit, manhole, tank, or cable.

1.3 REFERENCE STANDARDS

A. ASTM International (ASTM):

1. ASTM C33 - Standard Specification for Concrete Aggregates
2. ASTM C94 - Standard Specification for Ready-Mixed Concrete
3. ASTM C150 - Standard Specification for Portland Cement
4. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete
5. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
6. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete
7. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
8. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
9. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete in Place by Nuclear Methods
10. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Field Quality-Control Submittals:
 1. Mix Design:
 - a. Furnish flowable fill mix design for each specified strength.
 - b. Furnish separate mix designs when admixtures are required for the following:
 - 1) Flowable fill Work during hot and cold weather.
 - 2) Air entrained flowable fill Work.

- c. Identify design mix ingredients, proportions, properties, admixtures, and tests.
 2. Furnish test results to certify flowable fill mix design properties meet or exceed specified requirements.
- D. Delivery Tickets:
1. Furnish duplicate delivery tickets indicating actual materials delivered to Project Site.

1.5 QUALITY ASSURANCE

- A. In-place testing of Flowable Fill: In accordance with ASTM C403.
- B. Compressive testing of Flowable Fill: In accordance with ASTM D4832.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Minimum Conditions: The following minimum conditions shall be met at time of flowable fill placement.
 1. Do not install flowable fill during inclement weather.
 2. Ambient temperature must be at least 34 degrees Fahrenheit (4 degrees Celsius) and rising.
 3. Flowable fill shall be at 40 degrees F (4 degrees C).
 4. Subgrade on which flowable fill is to be placed shall be free of disturbed or soft material, debris, and water.

1.7 FIELD MEASUREMENTS

- A. Verify field measurements before installing flowable fill to establish quantities required to complete the Work.

PART 2 PRODUCTS

2.1 FLOWABLE FILL

- A. Flowable Fill:
 1. Composed of cement, pozzolans, fine aggregate, water, and admixtures.
 2. Low cement content.

3. Non-segregating, self-consolidating, free-flowing, and excavatable material which will result in a hardened, dense, non-settling fill.
4. Compressive strength at 28 days of 100 to 200 pounds per square inch (psi), if not otherwise shown in Drawings or specified.

2.2 MATERIALS

- A. Portland Cement: ASTM C150, Type I - Normal.
- B. Fine Aggregates: ASTM C33.
- C. Water: Clean and not detrimental to concrete.

2.3 ADMIXTURES

- A. Air Entrainment: ASTM C260.
- B. Chemical Admixture: ASTM C494.
- C. Fly Ash: ASTM C618 Class C or F, obtained from residue of electric generating plant using ground or powdered coal.

2.4 MIXES

- A. Mix and deliver flowable fill according to ASTM C94, Option C.
- B. Flowable Fill Design Mix:

ITEM	PROPERTIES
Cement Content	75 to 100 lb/cu yd
Fly Ash Content	[None]
Water Content	As specified
Air Entrainment	5 to 35 percent
28-Day Compressive Strength	Maximum 300 psi.
Unit Mass (Wet)	80 to 110 pcf
Temperature, Minimum at Point of Delivery	50 degrees F (10 degrees C)

- C. Provide water content in design mix to produce self-leveling, flowable fill material at time of placement.

2.5 SOURCE QUALITY CONTROL

- A. Test and analyze properties of flowable fill design mix and certify results for the following:
 - 1. Design mix proportions by weight of each material.
 - 2. Aggregate: ASTM C33 for material properties and gradation.
 - 3. Properties of plastic flowable fill design mix including:
 - a. Temperature
 - b. Slump
 - c. Air entrainment
 - d. Wet unit mass
 - e. Yield
 - f. Cement factor
 - 4. Properties of hardened flowable fill design mix including:
 - a. Compressive strength at 1-day, 7 days, and 28 days. Report compressive strength of each specimen and average specimen compressive strength.
 - b. Unit mass for each specimen and average specimen unit mass at time of compressive strength testing.
- B. Prepare delivery tickets containing the following information:
 - 1. Project designation
 - 2. Date
 - 3. Time
 - 4. Class and quantity of flowable fill
 - 5. Actual batch proportions
 - 6. Free moisture content of aggregate
 - 7. Quantity of water withheld

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify excavation specified in Section 31 23 16, Excavation and trenching specified in Section 31 23 17, Trenching is complete.
- B. Verify utility installation as specified in elsewhere in the specifications is complete and tested before placing flowable fill.
- C. Verify excavation is dry and dewatering system is operating, as may be required, prior to placement of flowable fill.

3.2 PREPARATION

- A. Support and restrain utilities to prevent movement and flotation during installation of flowable fill.
- B. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.
- C. Protect utilities and foundation drains to prevent intrusion of flowable fill.

3.3 INSTALLATION – FILL, BEDDING, AND BACKFILL

- A. Place flowable fill by chute, pumping, or other methods as approved by Engineer.
- B. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.
- C. Place flowable fill evenly on both sides of utilities to maintain alignment.
- D. Place flowable fill to elevations indicated on Drawings without vibration or other means of compaction.

3.4 INSTALLATION – FILLING ABANDONED UTILITIES

- A. As specified in Section 33 05 50, Existing Pipe Abandonment.

3.5 FIELD QUALITY CONTROL

- A. Perform inspection and testing according to ASTM C94.
 - 1. Take samples for tests for every 100 cubic yards of flowable fill, or fraction thereof, installed each day.

2. Sample, prepare, and test four compressive strength test cylinders according to ASTM D4832. Test one specimen at 3 days, one at 7 days, and two at 28 days.
 3. Measure temperature at point of delivery when samples are prepared.
- B. Further construction proceeding upon placed flowable fill will be permitted only after initial set is attained, as measured by ASTM C 403.
1. Perform in place penetration (density) tests using handheld penetrometer to measure penetration resistance of hardened flowable fill.
 2. Perform tests at locations as directed by Engineer.
- C. Defective Flowable Fill: The Engineer reserves the right to reject all flowable fill failing to meet the following test requirements or flowable fill delivered without the following documentation.
1. Test Requirements:
 - a. Minimum temperature at point of delivery.
 - b. Compressive strength requirements for each type of fill.
 2. Documentation: Duplicate delivery tickets.
- D. No traffic or construction equipment shall be allowed on flowable fill for a least 24 hours after placement.

3.6 CLEANING

- A. Remove spilled and excess flowable fill from Project Site.
- B. Restore facilities and Site areas damaged or contaminated by flowable fill installation to existing condition before installation.

END OF SECTION

**SECTION 31 25 00
EROSION AND SEDIMENT CONTROLS**

PART 1 GENERAL

1.1 SCOPE

- A. This section covers the requirements for temporary and permanent erosion and sedimentation control necessary to prevent migration of sediment and silt laden water to adjacent surface water bodies and drainage structures.
- B. The Contractor shall provide all materials, labor, and equipment necessary to install adequate erosion and sedimentation controls.

1.2 QUALITY CONTROL

The Owner will apply to COPO for a Major Land Disturbing Permit and a Storm Drainage Permit.. All fees and permit costs will be borne by the Owner. If Contractor proposes to modify the approved erosion control plan, the Contractor shall work with COPO to revise application/permit. Contractor shall obtain the final permit and shall be responsible for compliance with all permit provisions and shall accommodate all special inspections required thereof, all at no additional expense to the Owner beyond prices as bid.

1.3 SUBMITTALS

- A. Following the Preconstruction Conference, the Contractor will have sole responsibility for compliance with all of the permit requirements and the day-to-day implementation of the Erosion and Sediment Control Plan.

1.4 SCHEDULE

- A. Required temporary erosion and sedimentation control Best Management Practices (BMPs) must be constructed and in operation prior to land clearing or other construction activities to ensure that sediment laden water does not leave the site.
- B. Temporary sediment facilities shall be maintained in a satisfactory condition until such time that permanent ESC facilities are in place or sufficient vegetation has been established and potential for on-site erosion has passed.
- C. The implementation, maintenance, replacement, and additions to erosion/sedimentation control systems shall be the responsibility of the Contractor.

PART 2 PRODUCTS

2.1 CHECK DAM SAND OR GRAVEL BAGS

- A. Bags to be either burlap or woven "Geotextile" fabric filled with gravel or sand.

2.2 JUTE MATTING

- A. Be of a uniform open plain weave of unbleached, single jute yarn treated with a fire-retardant chemical.
- B. The yarn shall be of a loosely twisted construction and shall not vary in thickness by more than one-half of its normal diameter.
- C. Furnished in rolled strips 48 inches wide by approximately 50 yards long.
- D. Average weight of 0.92 pounds per square yard with an allowable tolerance of plus or minus 1 inch in width and 5 percent in weight.

2.3 FILTER FABRIC FENCE

- A. Filter Fabric
 - 1. Filter fabric for the erosion protection barriers shall be Mirafi 140, or equivalent.
- B. Wire
 - 1. Wire for the erosion protection barriers shall be 2 by 2 mesh, 12-gauge galvanized wire.
- C. Support Posts
 - 1. Support posts for the erosion protection barriers shall be minimum 2-inch by 2-inch, Douglas Fir No. 1, or better wood posts.

2.4 CLEAR PLASTIC COVERING

- A. Clear plastic covering for protection of slopes and cuts shall meet the requirements of the ASTM D2103 for Polyethylene sheeting having a minimum thickness of 6 mil.

2.5 INLET PROTECTION

- A. All new and existing stormwater inlets which collect stormwater runoff from a construction site shall be protected from sediment by the use of filters.

2.6 STABILIZED CONSTRUCTION ENTRANCE

- A. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.

PART 3 EXECUTION

3.1 EROSION CONTROL

- A. Erosion control provisions shall meet or exceed the requirements of the local agency having jurisdiction.
- B. When provisions are specified and shown on the drawings, they are the minimum requirements.
- C. Contractor shall not permit sediment-laden waters to leave the site.
- D. As construction progresses and seasonal conditions dictate, more siltation control facilities may be required. It shall be the responsibility of the Contractor to address new conditions that may be created and to provide additional facilities over and above minimum requirements as may be required.
- E. Provide temporary erosion control measures to prevent erosion from piles of topsoil or fill material. Before completing the Contract, any areas of bare soil shall be permanently seeded.
- F. Additional measures may be necessary depending on construction activity and weather. Contractor will be responsible for carrying out the erosion control provisions of the approved ESC Plan.
 - 1. Keep streets and paved surfaces clean of mud and debris. Install gravel construction entrances as shown on the Plans and maintain them for the duration of the construction period.

3.2 SILTATION CONTROL

- A. Siltation control is required. Check dams or silt fences may be placed in streams or ditches receiving stormwater from areas disturbed by construction.

3.3 FILTER FABRIC FENCES

- A. Filter fabric fence shall consist of filter fabric fastened to wire fabric with staples or wire rings.
- B. Wire shall be fastened to posts set at 6 foot-maximum centers.

- C. Fabric shall be buried into ground a minimum of 4 inches to prevent silt from washing under fabric.
- D. Fence shall be located to catch silt and prevent discharge to drainage courses.

3.4 EROSION CONTROL CHECK DAM

- A. Sand or gravel filled bags shall be installed in drainage way to catch silt.
- B. Spillway shall be lower than outer edge of dam. Leave a one sandbag gap in top row to provide spillway.

3.5 PLACING JUTE MATTING

- A. Seed and fertilizer shall be placed prior to placing of matting.
- B. Jute matting shall be unrolled parallel to the flow of water. Where more than one strip of jute matting is required to cover the given area, it shall overlap the adjacent mat a minimum of 4 inches. The ends of matting shall overlap at least 6 inches with the upgrade section on top.
- C. The up-slope end of each strip of matting shall be staked and buried in a 6-inch-deep trench with the soil firmly tamped against the mat. Three stakes per width of matting (one stake at each overlap) shall be driven below the finish ground line prior to backfilling of the trench.
- D. Engineer may require that any other edge exposed to more than normal flow of water or strong prevailing winds be staked and buried in a similar manner.
- E. Check-slots shall be laced between the ends of strips by placing a tight fold of the matting at least 6 inches vertically into the soil. These shall be tamped and stapled the same as up-slope ends. Check-slots must be placed so that one check-slot or one end occurs within each 50 feet of slope.
- F. Edges of matting shall be buried around the edges of catch basins and other structures as herein described. Matting must be spread evenly and smoothly and in contact with the soil at all points.
- G. Matting shall be held in place by approved wire staples, pins, spikes, or wooden stakes driven vertically into the soil. Matting shall be fastened at intervals not more than 3 feet apart in three rows for each strip of matting, with one row along each edge and one row alternately spaced in the middle. All ends of the matting and check-slots shall be fastened at 6-inch intervals across their width. Length of fastening devices shall be sufficient to securely anchor matting against the soil and driven flush with the finished grade.

3.6 PLACING CLEAR PLASTIC COVERING

- A. Clear plastic covering shall be installed on erodible embankment slopes.
- B. The clear plastic covering shall be installed immediately after completion of the application of roadside seeding. It is the intent of this specification that clear plastic covering will be in place before the fall rainfall begins.
- C. Maintain the cover tightly in place by using sandbags or ties on slopes with a minimum of 10-foot grid spacing in all directions. All seams shall be taped or weighted down full length. There shall be at least a 12-inch overlap of all seams.
- D. Immediately repair all damaged areas.

3.7 EXISTING DRAINAGE FACILITIES

- A. Should a storm sewer or culvert become blocked or have its capacity restricted due to siltation from Contractor's operations, the Contractor shall make arrangements with the jurisdictional agency for the cleaning of the facility at no additional expense to the Owner.
- B. Contractor shall install catch basin inserts in existing catch basins in the vicinity of, or adjacent to, clearing or construction activities to prevent sediment from entering the on-site stormwater conveyance system.

3.8 DRAINAGE DIVERSION

- A. Contractor may divert up-gradient surface runoff water around the site as required. Contractor will be responsible for routing diverted surface water to its original flow path downstream of the site and providing energy dissipation and/or dispersion as needed to mimic pre-diverted flow characteristics, as required by the Engineer.
- B. Drainage shall be restored to condition existing prior to construction unless otherwise shown on the drawings.

END OF SECTION

**SECTION 31 50 00
EXCAVATION SUPPORT AND PROTECTION**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes shoring and support systems of all types necessary to protect existing utility facilities and new utility facilities.
- B. The Contractor is responsible for the selection and design of excavation support systems and the design of utility support systems in conformance with Federal, State, and City requirements and the minimum design criteria specified herein.
- C. Temporary shoring is to be installed for protection of the existing trees to remain, structures to remain, buried utilities to remain, adjacent roadways and walkways, and surrounding properties.
- D. Care must be taken during the planning and construction of earth support systems to minimize settlements and displacements of the shoring system itself and to surrounding properties.
- E. Related Sections:
 - 1. Section 31 23 16, Excavation
 - 2. Section 31 23 17, Trenching
 - 3. Section 31 23 19, Dewatering
 - 4. Section 31 23 23, Fill
 - 5. Section 33 11 10, Water Utility Distribution and Transmission Piping.
 - 6. Section 33 31 10, Sanitary Utility Drainage Piping.
 - 7. Section 33 41 10, Storm Utility Drainage Piping.

1.2 DESIGN CRITERIA

- A. Design excavation support systems and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, railroad, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures to minimize ground movement or settlement, and to prevent damage to adjacent structures, roadways, railroads, and utilities.

- B. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.
- C. Design system so that water seepage is minimized. Provide dewatering and positive means for preventing sloughing and containing material behind lagging.
- D. Design system to prevent sloughing and to contain running sand and silt behind the lagging.
- E. Vertical support capacity shall be provided for wall systems and internal bracing elements for loads due to vertical force components and live loads on any portion of the system.
- F. Design calculations and shop drawings of all excavation support systems.
 - 1. Calculations and shop drawings shall be made and stamped by a registered Professional Civil or Structural Engineer experienced in the design of excavation support systems in the State of Washington.
 - 2. Comply with the applicable requirements of OSHA and the Washington State Building Code with respect to excavation and construction.

1.3 SUBMITTALS

- A. Section 01 33 00, Submittals - Submittal Procedures: Requirements for submittals.
- B. Excavation Support Systems
 - 1. Plans and details for trench and excavation support systems.
 - a. Shop drawings and supporting calculations shall meet the specified design criteria requirements and include the following:
 - 1) Arrangement, size, and details for individual excavation support system.
 - 2) Construction methods and sequencing to be used for the installation and removal of each excavation support system.
 - 3) Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably or if obstructions are encountered in the installation.
 - 2. Provide for Engineer review prior to the beginning of construction activities requiring such systems.
 - 3. No excavations shall be started until the submittal review is complete.

4. Review by the Engineer of the submitted design shall not be construed as a detailed analysis of the adequacy of the support system, nor shall any provisions of the above requirements be construed as relieving overall responsibility and liability for the work.
- C. Excavation Plan
1. Designed to prevent damage to existing and surrounding properties.
- D. Settlement Monitoring Plan, to include the following:
1. Detailed location of settlement monitoring points shown on the Drawings.
 2. Reference City benchmarks to be employed.
 3. Survey procedures (including name of survey crew leader and equipment to be used).
 4. Approach to recording surveyed readings and means of reporting of results to the Owner.
- E. Contingency Plan
1. Provide alternative procedures to be implemented if the excavation support systems are found to perform unfavorably or if obstructions are encountered in the installation of excavation support systems.
 2. Contingency plan is to demonstrate a preparedness to mitigate the effects of movement or settlement.
 3. The following minimum requirements for a contingency plan are:
 - a. Measures to be taken in order to protect existing facilities and neighboring properties from additional settlement or movement.
 - b. Identification of all material, manpower, equipment, and other items to be available and onsite at all times while excavations and dewatering activities are ongoing and reasonably after the work has been completed.
- F. Site Conditions Survey
1. Videotape surveys, photographs, and other data significant in noting the pre-construction conditions of the existing Project Site, as well as the pre-construction conditions of the neighboring properties and their existing structures.
 2. Provide to the Owner for record purposes prior to, but not more than 3 weeks before, commencement of any construction activities.

3. A complete set of all photographs and survey data of the post-construction conditions shall be completed and submitted prior to final inspection by the Owner and Engineer.

1.4 QUALITY ASSURANCE

- A. Contractor is solely responsible for quality assurance of temporary shoring.
- B. At each excavation support system location, provide the following:
 1. Continual verification system is planned, executed, and maintained in accordance with applicable codes, regulations, and good construction practice.
 2. Systematic observation of suitability of shoring materials.
 3. Installation, excavation, settlement, and lateral deflection monitoring.
 4. Groundwater control.
 5. Adjacent construction activities.
 6. Other factors, as necessary.
- C. Continually verify installation of the shoring is in conformance with the plans prepared by the Contractor's design engineers.

1.5 PERMITTING

- A. Secure all permits necessary to complete the requirements of this Section.

PART 2 PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be safe and in good condition and shall conform to local, state, and federal codes.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide sheeting, shoring, and other protection and support systems wherever required, in accordance with current local, state, and federal laws, codes, and ordinances.
- B. The Contractor is solely responsible for excavation protection and worker safety.

- C. The Contractor shall be solely responsible for the protection of existing utilities and structures. Under no circumstance shall work threaten the integrity (physical and operational) of these utilities and/or structures.

3.2 EXCAVATION SUPPORT SYSTEMS

- A. The excavation support systems shall not disturb the state of soil adjacent to the trench or excavation and below the excavation bottom.
- B. Water control measures shall be provided at all times in accordance with the requirements specified in Section 31 23 19, Dewatering.
- C. The support system shall extend below the main excavation bottom elevation to a depth adequate to prevent hydrostatic uplift, seepage and piping, and lateral movement and to adequately support applied vertical loads.
- D. Damage to existing utilities or structures during installation of excavation support system shall be avoided. If damage occurs, it shall be repaired at no cost to the Owner and to the satisfaction of the utility owner.
- E. A company representative from the excavation support system shall be onsite during initial setup of the system. Install excavation support system in strict conformance with the representative's recommendations.

3.3 CONTINGENCY PLAN IMPLEMENTATION

- A. Excess movements or settlements: Work shall be stopped immediately and the causes of excess or detrimental movements evaluated if:
 - 1. Damage is noted to existing site features or surrounding properties.
 - 2. Shoring wall movements exceed the limits specified herein or per submitted calculations.
- B. Immediately notify the Engineer and begin the implementation of the approved contingency plan to mitigate the effects of settlement or movement occurred.

3.4 REMOVAL OF SUPPORT SYSTEMS

- A. Removal of excavation support systems shall be performed in a manner that does not disturb or damage adjacent new or existing structures or utilities.
- B. Fill all voids immediately with specified backfill material.

- C. All damage to property resulting from removal shall be promptly repaired at no cost to the Owner. The Engineer shall be the sole judge as to the extent and determination of the methods and materials for repair.

END OF SECTION

DIVISION 32 – EXTERIOR IMPROVEMENTS

SECTION 32 11 23
AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes construction of an aggregate subbase and base course for placement under asphalt or concrete paving, unit paving, or placed and left exposed.
- B. Section Includes:
 - 1. Aggregate subbase
 - 2. Aggregate base course
- C. Related Sections:
 - 1. Section 31 22 13 - Rough Grading
 - 2. Section 31 23 17 - Trenching
 - 3. Section 31 23 23 - Fill
 - 4. Section 31 05 16 - Aggregates for Earthwork
 - 5. Section 32 12 16 - Asphalt Concrete Paving

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M288 - Standard Specification for Geotextile Specification for Highway Applications
 - 2. T11, Standard Method of Test for Materials Finer Than 75 μ m (No. 200) Sieve in Mineral Aggregates by Washing
 - 3. T27, Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates
 - 4. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
- B. ASTM International (ASTM):

1. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
2. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method
3. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
4. ASTM D2940 - Standard Specification for Graded Aggregate Material for Bases or Subbases for Highways or Airports
5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.3 DEFINITIONS

- A. Completed Course: Compacted, unyielding, free from irregularities and standing water, with smooth, tight, even surface, true to grade, line, and cross-section.
- B. Completed Lift: Compacted with uniform cross-section thickness.
- C. Keystone: Fine aggregate used to aid in binding of loose surface stone.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit data for geotextile fabric and herbicide.
- C. Materials Source: Submit name of aggregate materials suppliers.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Furnish each aggregate material from single source throughout the Work.

PART 2 PRODUCTS

2.1 SHOULDER AGGREGATE

- A. Of the size shown on the Plans.

- B. Coarse Aggregate: Type A1, Dense-Graded Aggregate as specified in Section 32 05 16, Aggregates for Earthwork.

2.2 DENSE-GRADED BASE AGGREGATES

- A. Of the size shown on the Plans.
- B. Coarse Aggregate: Type A5, Aggregate for Gravel Base as specified in Section 32 05 16, Aggregates for Earthwork.

2.3 OPEN-GRADED BASE AGGREGATES

- A. Of the size shown on the Plans.
- B. Coarse Aggregate: Type A7, Gravel Backfill for Drains as specified in Section 32 05 16, Aggregates for Earthwork.

2.4 SOURCE QUALITY CONTROL

- A. Perform tests necessary to locate acceptable source of materials meeting specified requirements.
- B. Final approval of aggregate material will be based on test results of installed materials.
- C. Should separation of coarse from fine materials occur during processing or stockpiling, immediately change methods of handling materials to correct uniformity in grading.

2.5 EQUIPMENT

- A. Compaction Equipment: Adequate in design and number to provide compaction and to obtain specified density for each layer.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. Obtain Engineer's acceptance of subgrade before placing base course or surfacing material.
- B. Verify compacted substrate is dry and ready to support paving and imposed loads.
 - 1. Proof roll substrate with equipment approved by the Engineer in minimum two perpendicular passes to identify soft spots.
 - 2. Remove soft substrate and replace with compacted fill as specified in Section 31 23 23.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place base course or surfacing materials in snow or on soft, muddy, or frozen subgrade.

3.3 HAULING AND SPREADING

A. Hauling Materials:

1. Do not haul over surfacing in process of construction.
2. Loads: Of uniform capacity.
3. Maintain consistent gradation of material delivered; loads of widely varying gradations will be cause for rejection.

B. Spreading Materials:

1. Distribute material to provide required density, depth, grade, and dimensions with allowance for subsequent lifts.
2. Produce even distribution of material on prepared surface without segregation.
3. Should segregation of coarse from fine materials occur during placing, immediately change methods of handling materials to correct uniformity in grading.
4. Maintain consistent gradation of material. Widely varying gradation will be cause for rejection.

3.4 CONSTRUCTION OF COURSES

A. Untreated Aggregate Base Course:

1. If the required compacted depth of the base course exceeds 6 inches, construct it in two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.
2. Completed Course Total Thickness: As shown on the Plans, 8-inch minimum.
3. Spread lift on preceding course to required cross-section. Place each layer in spreads as wide as practical and to the full width of the course before a succeeding layer is placed.
4. Lightly blade and roll surface until thoroughly compacted.

5. Add keystone to achieve compaction and as required when aggregate does not compact readily due to lack of fines or natural cementing properties, as follows:
 - a. Use 3/4-inch leveling course or surfacing material as keystone.
 - b. Spread evenly on top of base course, using spreader boxes or chip spreaders.
 - c. Roll surface until keystone is worked into interstices of base course without excessive displacement.
 - d. Continue operation until course has become thoroughly keyed, compacted, and will not creep or move under roller.
 6. Blade or broom surface to maintain true line, grade, and cross-section.
- B. Gravel Surfacing and Leveling Course:
1. Place shoulder aggregates in a single layer, or two or more layers of nearly equal thickness. The maximum compacted thickness of any one layer shall not exceed 9 inches.
 2. Spread on preceding course in accordance with cross-section shown.
 3. Blade lightly and roll surface until material is thoroughly compacted.
 4. Complete Total Thickness: As shown on the Plans, 8-inch minimum.

3.5 ROLLING AND COMPACTION

- A. Commence compaction of each layer of base immediately after spreading operations and continue until density of 95 percent of maximum density has been achieved as determined by AASHTO T99.
- B. Roll each layer of material until there is no appreciable reaction or yielding under the compactor before succeeding layer is applied.
- C. Shape and maintain the surface of each layer during compaction operations. Commence rolling at outer edges and continue toward center; do not roll center of road first.
- D. Apply water as needed to obtain specified densities.
- E. Place and compact each lift to the required density before succeeding lift is placed.
- F. Surface Defects: Remedy by loosening and rerolling. Reroll entire area, including surrounding surface, until thoroughly compacted.

G. Finished surface shall be true to grade and crown before proceeding with surfacing.

3.6 SURFACE TOLERANCES

A. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

B. Finished Surface of Untreated Aggregate: Within plus or minus 0.04-foot of grade shown at any individual point.

C. Overall Average: Within plus or minus 0.04-foot from crown and grade specified.

3.7 FIELD QUALITY CONTROL

A. Quality control testing shall be performed by an independent testing laboratory provided by the Owner.

B. Refer to table below for minimum sampling and testing requirements for aggregate base course and surfacing. The Owner reserves the right to complete additional testing.

Property	Test Method	Frequency	Sampling Point
Gradation	AASHTO T11 and AASHTO T27	One sample every 500 tons but at least every 4 hours of production	Roadbed after processing
Moisture Density (Maximum Density)	AASHTO T180	One test for every aggregate grading produced	Production output or stockpile
In-Place Density and Moisture Content	AASHTO T310	One for each 500 ton but at least every 10,000 square feet of area	In-place completed, compacted area

3.8 CLEANING

A. Remove excess material from the Work area. Clean stockpile and staging areas of all excess aggregate. Restore per Specifications as applicable.

END OF SECTION

SECTION 32 12 16
ASPHALT CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SCOPE

This section includes the construction of asphalt concrete pavement.

1.2 REFERENCE STANDARDS

- A. References herein to “AASHTO” shall mean Association of American State Highway Transportation Officials.

- B. Standard Specifications: Where the term “Standard Specifications” is used, such reference shall mean the current edition of the Washington Department of Transportation (WSDOT) Standard Specifications for Highway Construction. Where reference is made to a specific part of the Standard Specifications, such applicable part shall be considered as part of this section of the Specifications. In case of a conflict in the requirements of the Standard Specifications and the requirements stated herein, the requirements herein shall prevail.

1.3 DEFINITIONS

- A. Maximum Density Test (MDT): Theoretical maximum density of the bituminous mixture determined by multiplying the theoretical maximum specific gravity, determined by ASTM D2041 (Rice), by 62.4 pounds per cubic foot.

1.4 SUBMITTALS

- A. Aggregate Qualification Tests: In accordance with WSDOT Standard Specifications for Road, Bridge, and Municipal Construction Section 9-03.

- B. Job mix formula shall be an approved job mix formula. Submit formula, supplier, and product identification to the Engineer 30 days prior to start.
 - 1. Definite percentage for:
 - a. Each sieve fraction.
 - b. New asphalt cement.
 - c. Recycled asphalt pavement.

 - 2. Temperature of completed mix when discharged from mixer.

3. Character and quantity of anti-strip and recycling agents.

1.5 QUALITY ASSURANCE

- A. All testing to determine compliance with the specifications shall be performed by an independent testing laboratory contracted by the Contractor and approved by the Engineer. All testing costs shall be borne by the Contractor.
- B. A minimum of five nuclear densometer readings shall be taken in random locations within every test area. Each test area shall not exceed 200 tons of asphalt; however, smaller areas may be designated by the Engineer.
- C. The surface smoothness of the new asphalt concrete pavement shall be such that when a 10-foot straightedge is laid longitudinally across the paved area in any direction, the new pavement shall not deviate from the straightedge more than 1/8-inch. Surface drainage shall be maintained. Additionally, paving must conform to the design grade and crown and contain no abrupt edges, low or high areas or any other imperfections as determined by the Engineer. Pavement construction not meeting these requirements will be repaired by grinding the existing pavement to a 1-1/2-inch depth and replacing with Level 3, 1/2-inch dense graded Asphaltic Concrete the full width at no cost to Owner.

1.6 PRE-PAVING CONFERENCE

- A. Any supervisory personnel of the Contractor and any subcontractors who are to be involved in the paving work shall meet with the Engineer, at a time mutually agreed upon, to discuss methods of accomplishing all phases of the paving work.
- B. The Contractor shall be prepared to review the size and type of equipment to be used and the anticipated rate of placement to determine equipment needs.

PART 2 PRODUCTS

2.1 AGGREGATE MATERIAL

- A. Aggregate Base for Dense Graded Asphalt Concrete: The aggregate material shall be a clean, well-graded crushed base aggregate conforming to the Standard Specifications.

2.2 ASPHALT CONCRETE PAVEMENT

- A. Dense Graded Hot Mix Asphalt Concrete
 1. Use Class 1/2-inch, performance grade 58H-22. Conform to the requirements as specified in Section 5-04 of the Standard Specifications.

2. Asphaltic concrete pavement delivered to the site shall be accompanied by a ticket with the approved "job mix formula" number shown. Loads without tickets identifying the job mix formula will not be accepted.

B. Tack Coat

In accordance with Standard Specifications. Use CSS-1, CSS-1h, or performance graded asphalt.

C. Seal and Cover Coat

Asphalt material shall be CRS-1, CRS-2, or CRS-2P cationic emulsified asphalt. Fog seal shall be CSS-1 or CSS-1h.

1. .

D. Subgrade Stabilization

In the event that unstable materials are encountered during excavation, the additional excavation and installation of geotextile fabric and 12 inches of rock substructure will be required, as directed. Conform to the requirements as specified in 9-33 of the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.

PART 3 EXECUTION

3.1 AGGREGATE PAVEMENT BASE

- A. Place pavement base to the depth shown on the plans or as specified in all cases, pavement base shall be compacted to a minimum depth of 6 inches. Bring the top of the pavement base to a smooth, even grade at a distance below finished grade equivalent to the required pavement depth.
- B. Compact the pavement base with mechanical vibratory or impact tampers to a density of not less than 95 percent of the maximum density, as determined by AASHTO T-T180.
- C. Obtain the Engineer's acceptance of the subgrade before beginning construction of the aggregate base course.
- D. When, in the judgment of the Engineer, the weather is such that satisfactory results cannot be secured, suspend operations. Place no aggregate base course in snow or in soft, muddy, or frozen subgrade.
- E. If the required compacted depth of aggregate base course exceeds 6 inches, construct in two or more lifts of approximately equal thickness. Maximum compacted thickness

of any one lift shall not exceed 6 inches. Compact each layer to the specified density before a succeeding lift is placed.

3.2 ASPHALT CONCRETE PAVEMENT

- A. Construct asphalt concrete pavement in accordance with Section 5-04 of the WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.
- B. Conform to the requirements for prime coat and tack coat in the Standard Specifications. Tack coat all edges of existing pavement, manhole and clean out frames, inlet boxes, and like items. When rate is not specified, asphalt will be applied at the rate of 0.1-gallon per square yard.
- C. Obtain the Engineer's acceptance of the aggregate base course before beginning construction of the asphalt concrete wearing course.
- D. Hot mix asphalt shall be placed on dry, prepared surfaces, when air temperature in the shade of 40 degrees Fahrenheit (F) or warmer, unless otherwise authorized by the Engineer.
- E. Placing asphalt pavement during rain or other adverse weather conditions will not be permitted unless otherwise authorized by the Engineer, except that asphalt mix in transit at the time these adverse conditions occur may be placed provided it is of proper temperature, the mix has been covered during transit, and it is placed on a foundation free from mud or free-standing water.
- F. Correct any defects in material and workmanship, as directed, when determined detrimental by the Engineer. These include segregation of materials, non-uniform texture, and fouled surfaces preventing full bond between successive spreads of mixture. The corrections or replacement of defective material or workmanship shall be at the Contractor's expense.
- G. Compact the bituminous mixture to at least 92 percent of the Theoretical Maximum Density.
- H. The finished surface of each course of layer of mixture shall be of uniform texture, smooth, and free of defects and shall closely parallel that specified for the top surface finished grade. Remove and replace boils and slicks immediately with suitable materials.
- I. The surface of each layer when tested with a Contractor-furnished 10-foot straightedge shall not vary from the testing edge by more than 0.02-foot for underlying courses of pavements and 0.015-foot for finished top courses or wearing courses of pavements. At no point shall the finished top of the wearing course vary more than 0.03-foot from the specified finished grade.

- J. Lift thickness shall be as shown on the drawings or specified, but not to exceed 3 inches.
- K. Do not place asphalt concrete pavement on emulsified asphalt (tack coat) until the asphalt separates from the water (breaks) but before it loses its tackiness.
- L. Asphalt and sand seal edges where new asphalt concrete meets existing pavement.

3.3 FIELD QUALITY CONTROL

- A. Job mix will be sampled immediately behind the paving machine.
- B. Temperature of the mix will be measured immediately behind the paver.
- C. The theoretical maximum specific gravity of the bituminous mixture will be determined in accordance with ASTM D2041.
- D. Properties of the job mix will be measured using ASTM D2041.
- E. Density of the compacted job mix will be measured in accordance with ASTM D2922.

3.4 ADJUSTMENT OF EXISTING MANHOLE COVERS AND VALVE BOXES

Prior to placing asphalt concrete pavement, the Contractor shall make all necessary adjustments to existing manhole frames and covers, and valve box covers to ensure that the tops of the manhole covers or valve box lids are flush with the finished grade of the adjoining pavement or ground surface, and that valve boxes and PVC pipes are centered and plumb over operating nut valve.

END OF SECTION

**SECTION 32 91 13
SOIL PREPARATION**

PART 1 GENERAL

1.1 SUMMARY

- A. Furnish labor, material and equipment required for placement and amendment of topsoils for areas to be planted, and the establishment of finish grades as shown on the Drawings and as specified herein.
- B. Coordinate work with installation of other site work including earthwork, irrigation, seeding, and planting.
- C. Related sections include the following:
 - 1. City Standard Specifications for protecting trees remaining on-site that are affected by site operations.
 - 2. Division 32 Section 32 93 00, Plants for planting placement of amended topsoil backfill.

1.2 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of amended topsoil soil.
- B. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil
- C. Amended Topsoil: Native or imported topsoil or surface soil modified with organic soil amendments and organic fertilizers.
- D. Subgrade: Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
- E. Topsoil: See Part 2 – Products.

1.3 SUBMITTALS

- A. Product Data. Include Material Safety Data Sheets (MSDS) where applicable: For the following:
 - 1. Organic Fertilizers, including application rates.
 - 2. Organic Soil Amendments.
- B. Samples for Verification: For the following:

1. 1/2 cubic foot compost.
 2. 1/2 cubic foot of each imported topsoil. Furnish one sample from each site from which soil is to be furnished.
- C. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:
1. Manufacturer's certified analysis for standard products.
 2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- D. Qualification Data: For testing agencies.
- E. Material Test Reports:
1. Soil Fertility and Agricultural Suitability Analyses and Recommendations Reports for the following:
 - a. Existing on-site topsoil: From three typical locations as selected by Owner's Representative, minimum 30 days prior to beginning soil preparation work.
 - b. Imported topsoil: Minimum 30 days prior to beginning soil preparation work.
 - c. Amended topsoils: Provide soil analyses and results for soil samples taken from 3 typical locations as selected by Owner's Representative, minimum 7 days after soil preparation work has been completed and prior to installing plants.
 2. Compost Analysis: Provide analysis for one representative sample of compost minimum 30 days prior to compost being delivered to Project Site and an analysis for one representative sample of compost delivered to the Project Site.
 3. Soil Compaction Test: Provide results of soil compaction tests minimum of 7 days prior to planting and seeding.
- F. Delivery Slips: Provide delivery slips as proof of shipment of specified materials.

1.4 QUALITY ASSURANCE

- A. Soil Fertility and Agricultural Suitability-Testing Laboratory Qualifications: An independent laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
- B. Soil Analyses: Furnish soil analyses by a qualified soil-testing laboratory stating:

1. Soil Composition: USDA particle size analysis indicating percentages of sand, silt and clay, and percent organic matter.
 2. Macro and micro nutrient fertility tests as determined by pH, salinity, nitrate nitrogen, ammonium nitrogen, phosphate phosphorous potassium, calcium, magnesium, soluble copper, zinc, manganese, iron, saturation extract boron and sodium analyses.
 3. Sodium Absorption Ratio (SAR).
 4. Recommendations by the soil testing lab for fertilizer and soil amendments in pounds per 1,000 square foot or tons per acre, as necessary to correct soil deficiencies.
- C. Compost Testing Laboratory Qualifications: An independent laboratory, with the experience and capability to conduct the testing indicated following U.S. Composting Council Seal of Testing Assurance (STA) procedures, or equivalent.
- D. Compost Analysis: Provide documentation from supplier that compost has reached a monitored temperature of 140 degrees Fahrenheit for at least one week. Engage an independent soil testing laboratory to test representative sample(s) of compost and furnish compost analysis report for the following parameters:
1. Percent organic matter, percent moisture, percent inerts (foreign matter), pH, soluble salts, and particle size.
 2. Nutrient content, including: Nitrogen (N), Phosphorus (P), Potassium (K), Calcium (Ca), and Magnesium (Mg) and Sulfur (S).
 3. Trace Metals, including: Arsenic (As), Cadmium (Cd), Chromium (Cr), Copper (Cu), Lead (Pb), Mercury (Hg), Nickel (Ni), and Zinc (Zn).
 4. Maturity Indicator. Provide bio-assay results. Provide Carbon-Nitrogen ratio.
 5. Stability Indicator: Provide respiration test results.
- E. Request inspection and allow observation by Owner's Representative of prepared soils before planting.
- F. Soil Compaction Testing: Furnish soil compaction standard tests per ASTM 698. Request inspection and allow observation by Owner's Representative of prepared soils before planting.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver packaged materials in manufacturer's unopened containers fully identified by name, brand, type, weight and analysis.
- B. Store and handle packaged materials to prevent damage and intrusion of foreign matter.
- C. Store stockpiled topsoil in area designated by Owner's Representative. Provide erosion control measures for stockpiled topsoil on site to prevent contamination of the soil. Refer to Standard Specifications for control of dust and erosion.

1.6 SOIL AMENDMENT BID QUANTITIES

- A. Bid quantities and types of soil amendments shall be based upon those listed in this Section. Types of amendments required and quantities shall be adjusted as necessary based upon actual results of soil fertility and agricultural suitability analyses and recommendations for on-site topsoils.
- B. For bidding purposes only, calculate the following amounts per 6-inch lift of topsoil over 1000 square-feet of landscape area:
 - 1. 25 lbs. Gypsum (Calcium sulfate)
 - 2. 35 lbs. Calcium carbonate limestone
 - 3. 35 lbs. Dolomite limestone
 - 4. 6 cu-yds Compost

1.7 SITE CONDITIONS

- A. Topsoil placement and soil preparation shall not take place during periods where saturated soil or surface water is present in work areas.
- B. Work shall not take place when temperature is less than 32 degrees Fahrenheit, or when frozen soil exists on site.

1.8 COORDINATION

- A. Coordinate soil preparation such that topsoil, soil amendments and fertilizers are incorporated into ground fill areas in specified lifts to specified depths below finish grade for both planting areas and lawn areas. Topsoils shall be amended per recommendations of the Soils Testing Laboratory.
- B. Coordinate work with installation of other site work, including irrigation, seeding, and planting.

PART 2 PRODUCTS

2.1 TOPSOIL

- A. Topsoil Definition: ASTM D 5268; natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles, conforming to USDA classification for Loam or Sandy Loam; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inches in any dimension; and free of weeds, roots, and other deleterious materials, with the following physical properties:
1. Organic Matter: 6 percent minimum.
 2. Sodium Adsorption Ratio (SAR): less than 6.0.
 3. Saturation Extract concentration for Boron: less than 1.0
 4. pH range of from 6 to 8 (plus 0, minus 0.5).
 5. Saturation Extract Conductivity: less than 4.0 dS/m @ 25 degrees Celsius as determined in a saturation extract.
 6. Non-soil components: less than 1 percent by volume.
 7. Heavy metal concentrations: below the USDA per year load limit.
 8. Minimal weed seed.
 - a. If regenerative noxious weeds (including, but not limited to, quack grass, nutsedge grass, and horsetail) are present in the soil, all resultant growth including roots shall be removed throughout one-year period after acceptance of work at no additional cost to Owner.
- B. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Ensure no contamination of the soils occurs during earthwork and grading, and that the soil remains friable and free of debris.
1. Import Topsoil: Supplement on-site topsoil with imported or manufactured topsoil from off-site sources when quantities are insufficient. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

2.2 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-decomposed, commercially manufactured, stable, and weed-free organic matter from agricultural, food, biosolids, or yard debris sources; pH range of 5.5 to 8.0; 100 percent passing through 3/4-inch sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and shall conform as follows:
1. Tested, at minimum, every six months for noxious weeds.
 2. Organic matter source (feedstock): Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
 3. Organic Matter Content: 60 to 80 percent of dry weight as determined by ash method.
 4. Moisture Content: 35 to 55 percent by weight
 5. Free of refuse (less than 1 percent by dry weight), plastics, contaminants or any material toxic to plant growth.
 6. Processed to meet U.S. Composting Council's Seal of Testing Assurance Program, or equivalent.
 7. Carbon to Nitrogen Ratio: 40 to 1 or lower.
 8. Composted for a minimum of 9 months and reach a monitored temperature of 140 degrees Fahrenheit for at least one week.
 9. Available Suppliers:
 - a. Cedar Grove Compost; 17825 Cedar Grove Road Southeast Maple Valley, WA 98038 (425) 432-2395.
 - b. Bailey Compost; 12711 Springhetti Road Snohomish, WA 98296 (360) 568-8826.
 - c. Or equal.

2.3 FERTILIZER

- A. Organic fertilizer composition and rate to be determined and adjusted based upon soil analysis report. For bidding purposes, assume: Walts Organic Fertilizer, Organic Garden Blend 6-2-5, or approved equal.
1. Application rate @ 20 pounds per 1000 square feet in all planting beds and seeded areas.

- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium derived from natural organic sources in the following composition:
 1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing agency.

2.4 BIORETENTION SOIL MIX

- A. Mineral Aggregate for Default BSM Percent Fines: A range of 2 to 4 percent passing the #200 sieve is ideal and fines should not be above 5 percent for a proper functioning specification according to ASTM D422.
- B. Aggregate Gradation for Default BSM: The aggregate portion of the BSM should be well-graded. According to ASTM D 2487-98 (Classification of Soils for Engineering Purposes (Unified Soil Classification System)), well-graded sand should have the following gradation coefficients:
 1. Coefficient of Uniformity ($C_u = D_{60}/D_{10}$) equal to or greater than 4, and
 2. Coefficient of Curve ($C_c = (D_{30})^2/D_{60} \times D_{10}$) greater than or equal to 1 and less than or equal to 3.
- C. The following table provides a gradation guideline for the aggregate component of the default bioretention soil mix (Hinman, 2009). The sand gradation below is often supplied as a well-graded utility or screened. With compost this blend provides enough fines for adequate water retention, hydraulic conductivity within recommended range (see below), pollutant removal capability, and plant growth characteristics for meeting design guidelines and objectives.

Sieve Size	Percent Passing
3/8"	100
#4	95-100
#10	75-90
#40	25-40
#100	4-10
#200	2-5

- D. Where existing soils meet the above aggregate gradation, those soils may be amended rather than importing mineral aggregate.
- E. Compost to Aggregate Ratio, Organic Matter Content, and Cation Exchange Capacity for Default BSM
 1. Compost to aggregate ratio: 60-65 percent mineral aggregate, 35 – 40 percent compost by volume.
 2. Organic matter content: 5 – 8 percent by weight.
 3. Cation Exchange Capacity (CEC) must be > 5 milliequivalents/100 g dry soil Note: Soil mixes meeting the above specifications do not have to be tested for CEC. They will readily meet the minimum CEC.
- F. Compost for Default BSM
 1. To ensure that the BSM will support healthy plant growth and root development, contribute to biofiltration of pollutants, and not restrict infiltration when used in the proportions cited herein, the following compost standards are required.
 2. Meets the definition of “composted material” in WAC 173-350-100 and complies with testing parameters and other standards in WAC 173-350-220.
 3. Produced at a composting facility that is permitted by the jurisdictional health authority. Permitted compost facilities in Washington are included in a spreadsheet titled Washington composting facilities and material types – 2017 at the following web address: <https://ecology.wa.gov/Waste-Toxics/Reducing-recycling-waste/Organic-materials/Managing-organics-compost>
 4. The compost product must originate a minimum of 65 percent by volume from recycled plant waste comprised of “yard debris,” “crop residues,” and “bulking agents” as those terms are defined in WAC 173-350-100. A maximum of 35 percent by volume of “post-consumer food waste” as defined in WAC 173-350-100, but not including biosolids or manure, may be substituted for recycled plant waste.
 5. Stable (low oxygen use and CO2 generation) and mature (capable of supporting plant growth) by tests shown below. This is critical to plant success in bioretention soil mixes.
 6. Moisture content range: no visible free water or dust produced when handling the material.
 7. Tested in accordance with the U.S. Composting Council “Test Method for the Examination of Compost and Composting” (TMECC), as established in the

Composting Council's "Seal of Testing Assurance" (STA) program. Most Washington compost facilities now use these tests.

8. Screened to the following size gradations for Fine Compost when tested in accordance with TMECC test method 02.02-B, Sample Sieving for Aggregate Size Classification." Fine Compost shall meet the following gradation by dry weight
 - a. Minimum percent passing 2": 100%
 - b. Minimum percent passing 1": 99%
 - c. Minimum percent passing 5/8": 90%
 - d. Minimum percent passing 1/4": 75%
9. pH between 6.0 and 8.5 (TMECC 04.11-A). "Physical contaminants" (as defined in WAC 173-350-100) content less than 1% by weight (TMECC 03.08-A) total, not to exceed 0.25 percent film plastic by dry weight.
10. Minimum organic matter content of 40% (TMECC 05.07-A "Loss on Ignition)
11. Soluble salt content less than 4.0 dS/m (mmhos/cm) (TMECC 04.10-A "Electrical Conductivity, 1:5 Slurry Method, Mass Basis")
12. Maturity indicators from a cucumber bioassay (TMECC 05.05-A "Seedling Emergence and Relative Growth) must be greater than 80%for both emergence and vigor")
13. Stability of 7 mg CO₂-C/g OM/day or below (TMECC 05.08-B "Carbon Dioxide Evolution Rate")
14. Carbon to nitrogen ratio (TMECC 05.02A "Carbon to Nitrogen Ratio" which uses 04.01 "Organic Carbon" and 04.02D "Total Nitrogen by Oxidation") of less than 25:1. The C:N ratio may be up to 35:1 for plantings composed entirely of Puget Sound Lowland native species and up to 40:1 for coarse compost to be used as a surface mulch (not in a soil mix).

PART 3 EXECUTION

3.1 EXAMINATION OF SITE CONDITIONS

- A. Examine for site conditions that will adversely affect execution, permanence, quality of work, and survival of plant material and grasses.
- B. Verify that subgrades and slopes of lawn and planting areas are acceptable to Owner's Representative prior to commencing work of this Section.

- C. Should the Contractor find any discrepancies between the Drawings and the physical conditions, inform the Owner's Representative immediately for clarification.
- D. Begin Work required under this Section only after conditions are satisfactory.

3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities, and existing lawns and exterior plants from damage caused by soil preparation operations.
- B. Prepare soils at a time when moisture conditions will permit proper cultivation.
- C. Remove stones over 1-inch diameter, sticks, roots, mortar, concrete, rubbish, debris, and all materials harmful to plant life, and legally dispose of them off Owner's property.
- D. Remove as required to eradicate noxious weed growth and roots.
 - 1. Achieve complete removal of all weeds within all areas receiving new plantings and lawn areas.
 - 2. In planting beds, kill achieved by working soil is permissible for annual non-noxious broad-leaf type weeds.
- E. Locate and securely mark or flag irrigation sprinkler heads, area drains, catch basins, clean outs, manholes, valve boxes, and other site improvements not extending above finish grade. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, in accordance with Section 31 25 00

3.3 SOIL PREPARATION FOR PLANTING AREAS

- A. This article pertains to areas indicated on the Drawings where plantings of trees, shrubs and ground cover plants are scheduled.
- B. Prepare subgrades by excavating and removing soil, rock and other construction material to 12 inches below finish grade. Cross-rip subgrades to depth of 6 inches prior to placing topsoil. See Section 31 23 16, Excavation for excavation and preparation of subgrades.
- C. Place topsoil to depth as noted on Drawings then place compost, soil amendments, and fertilizers as recommended in Agricultural Soil Suitability Report per 1,000 square feet and rototill thoroughly to a depth of 8 inches. Place remainder of topsoil, compost, soil amendments, and fertilizers as recommended in Agricultural Soil Suitability Report per 1,000 square feet and rototill thoroughly to a depth of 8 inches, allowing for compaction, natural settlement, and depth of specified mulch.

1. It is the Contractor's option to set up a facility on-site for the preparation and amendment of topsoils, instead of preparing and amending the topsoils in place as indicated in the paragraph above.
 2. Set up facility in location as directed by Owner's Representative.
- D. Water lightly and allow planting mix to settle. Add additional material at mixture indicated in paragraph above to bring soil level to grades shown on the Drawings with allowance at pavement edges for mulch placement. Provide compaction to 85 percent relative density or as indicated in the WSDOT Standard Specifications.
- E. Meet lines, grades and elevations shown, after light rolling and natural settlement. Fine grade shrub and ground cover areas to smooth even surface with loose, uniformly fine texture. Rake and drag shrub and ground cover areas to remove ridges and fill depressions to obtain firmness and finish grades preparatory to receiving planting.
- F. Remove stones over 1/2-inch in any dimension and sticks, roots, rubbish and other extraneous matter.

3.4 SOIL PREPARATION FOR PLANTING PITS OF TREES

- A. This article pertains to tree planting when occurring on an individual basis.
1. Backfill Mix: Prepare backfill mix and place in planting pits as specified in Section 32 93 00, Plants.
 2. Grade smooth to elevations shown.

3.5 SOIL PREPARATION UNDER EXISTING TREES

- A. Remove vegetation not indicated to remain beneath canopy of existing trees. Take care not to disturb roots of existing trees.
- B. Lightly rake areas and add amended topsoil to meet proposed grades.

3.6 FINE GRADING

- A. Finish grade after full settlement including mulch, shall be 1 inch below tops of curbs, walks, or existing grades in shrub areas and 3/4 inch lower in lawn areas.
- B. Slope all areas to prevent puddling and drain surface water toward catch basins, drains, curbs, or off-site as shown on Drawings.
- C. Soil in all areas shall be thoroughly settled, with a smooth surface free of humps and hollows, and shall be firm enough to resist undesirable impressions when stepped upon.

- D. Use levels, screens, drags, or any other equipment necessary to establish and verify grades and surfaces.
- E. Finish grade lawn, grass and planting areas to smooth, even surface with loose, uniformly fine texture.
- F. Roll, rake, and drag lawn areas, remove ridges and fill depressions with amended topsoil to obtain firmness and finish grades as indicated.
- G. Notify Owner's Representative 36 hours in advance to review fine grading of lawn, grass and planting areas. Finish grades shall be prepared to the satisfaction of the Owner's Representative prior to planting.
- H. See Section 32 93 00, Plants for mulch placement.

3.7 CLEAN-UP

- A. Clean up excess materials and debris from project site upon completion of work or sooner if directed by the Owner's Representative.
- B. Leave in neat and tidy condition daily.

3.8 DISPOSAL

- A. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION

SECTION 32 91 21
FINISH GRADING AND SEEDING

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the work necessary for the finish grading, erosion control, and establishment of seeding, complete, including furnishing and delivery of labor, materials and equipment.

1.2 SUBMITTALS

The following submittals are required as part of this work:

- A. Project Schedule indicating dates for delivery of materials, completion of rough grading, preparation of seedbed, installation of erosion control seeding.

PART 2 MATERIALS

2.1 IMPORTED TOPSOIL

Imported topsoil shall be a natural, friable soil, representative of productive soils in the vicinity. It shall be obtained from well-drained areas, free from admixture of subsoil and foreign matter and objects larger than 2-inches in diameter, toxic substances, and any other deleterious material which may be harmful to plant growth or be a hindrance to grading, planting and maintenance. Imported topsoil supply shall be approved by the Engineer.

2.2 SOIL CONDITIONERS

- A. Organic Material

Peat - A natural material formed by the decomposition of reeds, sedges, or mosses from freshwater sites. Peat shall be free from lumps, roots, or stones, and organic matter shall be not less than 90 percent on a dry weight basis.

Rotted Sawdust - Nitrogen stabilized, 1/4-inch minus, clean sawdust or shavings, free from weed seed, and containing no chemicals or materials harmful to plant life.

Manure - Well-rotted stable or cattle manure, reasonably free from weed seed and refuse, containing no chemicals or materials harmful to plant life. Manure shall be no less than 2 months or more than 1 year old. Sawdust and shavings shall not exceed 50 percent content of manure.

Mushroom Compost - Spent mushroom growing compost.

- B. Sand - Clean, coarse, ungraded sand, meeting the requirements of ASTM C 33 for fine aggregate.

2.3 FERTILIZER

Slow Release Fertilizer: Slow release fertilizer for use in erosion control seeding containing 22% nitrogen, 16% available phosphoric acid, and 8% potash, including a minimum of 2% sulfur. The fertilizer shall contain not less than 30% available water-insoluble nitrogen derived by incorporating urea formaldehyde.

2.4 SEED

- A. The list of approved seed varieties are specifically identified list below. They shall be applied at the given rates. Source identified seed shall be fourth generation or earlier. Non-Source Identified seed shall meet or exceed Washington State Department of Agriculture Certified Seed Standards. Seeds shall be certified “Weed Free”, indicating there are no noxious or nuisance weeds in the seed.
- B. Lawn Mix - shall be applied at 200 pounds per acre and the maximum weed seed shall be no more than 0.5%. Grass seed of the following composition, proportion, and quality shall be applied as follows:

Kind and Variety of Seed	Percent	Minimum	Minimum
	By Weight	Pure Seed	Germination
Equal Mix 3-Perennial Ryegrasses	60%	98%	90%
One Chewing Fine Fescue	20%	98%	90%
One Creeping Red Fescue	20%	98%	90%

Approved Seed Type:

Perennial Ryegrasses

Fiesta 4	Manhattan 5	Grand Slam GLD	Karma	Tetradark
SR 4650	Karma	Banfield	Sideways	Dasher 3
Thrive	Wicked	Pavilion		

Creeping Red Fescue

Salsa Cindy Jasper Salem

Chewing Fescue

Tiffany Shadow II Treazure E Longfellow
Weekend Tamara Enjoy Victory

2.5 EROSION CONTROL MATTING

A. See Section 32 93 00 Plants.

2.6 EROSION CONTROL SEEDING MULCH

Wood or straw mulch processed so that the fibers are uniformly suspended under agitation in water. Blend the mulch with seed, fertilizer, and other typical additives in a hydroseeding mixture to form a homogeneous slurry. The processed mulch shall have the ability to hold grass seed in contact with soil. Fibers shall have moisture-absorption and percolation properties to form a blotter-like cover on the ground. Ship in packages of uniform weight (+/- 5%) and labeled with manufacturer's name and air-dry weight.

2.7 TACKIFIER

Emulsion designed to retain moisture and heat in the soil. Mulch shall be chemically inert, nontoxic to plants, humans, and animals. Tackifier shall be J-Tac, Sentinell Tackifier additive, or equal.

PART 3 EXECUTION

3.1 FINISH GRADING PROCEDURES

- A. Mix topsoil with rough grade fill material and mix thoroughly to a depth indicated on drawings
- B. Finish Grading: Spread fill/topsoil material and rake the area to a uniform grade so that all areas drain, as indicated on the Drawings.
- C. Preparation of Seedbed: Remove all trash and stones exceeding 2-inches prior to seeding.

3.2 TIME OF SEEDING

- A. Conduct seeding operations under favorable weather conditions during seasons which are normal for such work generally from April 1 to June 1, and Sept. 1 to November 1.
- B. Guarantee germination of erosion control seeding by November 1 at the latest.
- C. Seed all native plant species in fall only.

3.3 SEEDING

- A. Seeding operations shall occur in two applications. The first application shall include seed, fertilizer, and mulch. The second application shall consist of tackifier and mulch only and be applied immediately after the first seeding.

END OF SECTION

**SECTION 32 93 00
PLANTING**

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Scope of Work: The work includes furnishing and installation of trees, shrubs, ground covers, fertilizers, mulch, planting accessories, cleanup, and landscape maintenance until final acceptance.

1.3 RELATED SECTIONS

- A. Coordinate related work specified in other parts of the Contract Documents, including but not limited to the following:
 - 1. Division 31 Earthwork.
 - 2. Section 32 91 13 Soil Preparation.

1.4 QUALITY ASSURANCE

- A. Comply with sizing and grading standards of "American Standard for Nursery Stock," current edition.
- B. Nomenclature: conform to HortusThird compiled by the L.H. Bailey Arboretum, Cornell University, 1976.
- C. All plants shall be nursery grown materials that have been grown in a nursery for at least one year. Nursery climatic conditions must be similar to those in the locality of the project. All plants to be weed free at the time of planting.
- D. Planting stock furnished shall be at least the minimum size indicated. Larger stock is acceptable at the discretion of the Owner at no additional cost to the Owner, and providing that the larger plants will not be cut back to size indicated. Provide plants indicated by a range between two (2) measurements so that only a maximum of twenty-five percent (25%) are of the minimum size indicated and seventy-five percent (75%) are of the maximum size as shown on the Drawings. Measurements of plant sizes shall be in accordance with American Standard for Nursery Stock as published by the American Association of Nurseryman, Inc.

1.5 REFERENCES

- A. This section incorporates by reference the latest revisions of the following documents.
 - 1. American Association of Nurserymen (AAN):
 - a. American Standard for Nursery Stock (ASNS), ANSI Z60.1 (ASNS).
 - 2. American Joint Committee on Horticultural Nomenclature:
 - a. Standardized Plant Names (SPN).
 - 3. Revised Code of Washington (RCW):
 - a. RCW Chapter 17.10 Noxious Weeds – Control Boards.
 - 4. Tree Care Industry Association (TCIA):
 - a. ANSI A300 Standards.

1.6 COORDINATION

- A. Coordinate preparation of planting soil, irrigation installation, and planting with subgrade work.
- B. Coordinate layout and installation of plant material with installation of irrigation system to ensure that there will be complete head-to-head coverage of the planted areas. Final plant placement to be approved by Owner before planting.
- C. The irrigation system shall be installed, tested, and accepted before planting begins.

1.7 ALTERNATES

- A. If the specifies plants cannot be supplies due to non-availability, immediately inform the Owner in writing. Plant substitutions will be allowed only upon written approval by the Owner.

1.8 LANDSCAPE PRECONSTRUCTION MEETING

- A. Arrange a preconstruction meeting at least 14 days prior to start of work. Include the Owner, Contractor, Planting and Irrigation Subcontractor(s), and other Subcontractors.
- B. Review the proposed landscape schedule, source of soils and plants, consideration of substitutions, review of specifications, soil preparation, and planting and irrigation procedures.
- C. Provide meeting notes for approval by Owner.

1.9 SUBMITTALS

A. Plant Materials:

1. Plant Procurement:

- a. Within 60 days of the Notice to Proceed, verify all sources of supply to ensure that all plants of the species, size, and quality specified are available. It is the Contractor's responsibility to locate plant materials.
- b. Submit list of all plant material to the Owner for acceptance prior to shipment to site.
- c. When requested by the Owner, produce sale receipts for nursery stock and certificates of inspection from required authorities.

2. Planting Quantity: Total number of plants shall be as indicated on planting plan. If this total differs from the plant legend, notify the Owner before bid date. The plan takes precedence over the plant schedule for total plant quantity.

B. Mulch

1. Samples: Submit one-gallon container sized samples of Coarse Bark Mulch and Bioretention Area Mulch. Provide sources of the mulches.

C. Bioretention Area Mulch (Medium Compost) Analysis Report:

1. Medium Compost shall be tested at a minimum in accordance with the U.S. Composting Council "Testing Methods for the Examination of Compost and Composting" (TMECC), as established in the Composting Council's "Seal of Testing Assurance" (STA) program.
2. Provide written verification and lab analyses that the material complies with the processes, testing, and standards specified in WAC 173-350 and these Specifications. An independent Seal of Testing Assurance (STA) Program certified laboratory or a laboratory accredited by WA Ecology for the specified methods shall perform the analyses. Lab analysis shall be for the compost delivered on site for project use.
3. A copy of the STA laboratory's Seal of Testing Assurance STA certification as issued by the U.S. Composting Council, or a copy of the Ecology-certified laboratory's accreditation for the specified methods.
4. The test shall measure and confirm product requirements in accordance with Section 32 91 13 Article 2.2 except particle size gradation shall be per paragraph 2.4BIOSWALE MULCH below.

D. Planting Accessories

1. Manufacturer's product literature, including specific product, model, finishes, features, and installation instructions for the following:
 - a. Landscape Steel Edging with Stakes:
 - 1) Product Data: For steel edging and stakes, submit selected manufacturer's technical data and standard installation instructions.
 - 2) Samples: Submit 8" long sample of edging and stake in specified color.
 - b. Tree root barrier: One 12-inch length sample and product information
 - c. Tree stakes and guys: product information.

E. Fertilizer and Plant Treatment Material

1. Provide product data. When requested by the Owner, produce sale receipts products installed at the site.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Package plant materials in balls, boxes, containers, or tubes, so as to reach the site undamaged and in a moist, healthy, unwilted conditions. Balled and burlapped root ball shall be firm and intact. Broken and loose burlap wrapped root balls will be rejected.
- B. Conifers grown in root control bags are not allowed and will be rejected.
- C. If planting is delayed more than 24 hours after delivery, set balled and burlapped plants on the ground, well protected with soil. Adequately cover all roots of bare root material with soil. Protect rootballs from freezing, sun, drying winds, or mechanical damage. Water as necessary until planted. Do not heel in plants for more than one (1) week.
- D. Handle and deliver landscape edging and stakes in a manner to protect from bending, scratching, chipping, and other damage. Store landscape edging and stakes in a dry location, protected from the weather and moisture.

1.11 PROJECT/SITE CONDITIONS

- A. Planting Time:
 1. Do not install plants when ambient temperatures may drop below 35 degrees F or climb above 80 degrees F.
 2. Do not install plants when wind velocity exceeds 30 MPH.

3. Bareroot Stock: Plant bareroot stock from October to February only.
 4. Balled and Burlapped Stock: Plant during periods which are normal for such work, as determined by season, weather conditions and accepted practice.
 5. Do not plant when ground is frozen or excessively wet.
- B. Disposal of Waste Materials:
1. Remove all plastic labels, materials, and synthetic burlap from planting pit, after plant is in place. Remove from site.

1.12 WARRANTY

- A. Warrant all plants and planted areas in accordance with the requirements of the Contract for a period of two (2) years following acceptance of the Landscape work by the Owner.
- B. The warranty shall be for loss, deterioration, damage, or disturbance of plants for any reason, with the exceptions of vandalism and extreme climatic conditions, as determined by the Owner, during the warranty period. Losses, deterioration, damage, or disturbance shall be cause for rejection of plants and shall require repair and or replacement.
- C. Deterioration shall include but not be limited to substantial dieback of branches resulting in a deficiency of foliage or improper balance of branching as determined by the Owner.
- D. Replacement plants shall be the same species as originally specified and shall be of a size equal to the remaining healthy trees, shrubs, or groundcovers. Repairs and replacements shall be made within two (2) calendar weeks following notification by the Owner. If notification occurs during the non-planting season, a written request may be submitted to the Owner permission to defer planting until the proper season. All replacement plants shall have their warranty period extended for one (1) year from the date of replacement installation.
- E. Do all work necessary to prevent similar, continuing losses of replacement and remaining plants.
- F. During the warranty period the Contractor shall not be responsible for the expense of replacing plants which are destroyed or damaged 1) by vandalism, or 2) extreme climatic conditions.
- G. Immediately notify the Owner of any plants which are removed, destroyed, or damaged by vandalism or by extreme climatic conditions. Replace plants only when authorized by a written Field Directive.

- H. An extreme climatic condition shall be the occurrence of any one of the following events:
1. An air temperature 20 degrees above the average daily high temperature or 20 degrees below the average daily low temperature for the date (s) in question. Average daily temperature shall be based on climatic data provided by the National Oceanic and Atmospheric Administration or the U.S. Weather Bureau.
 2. The occurrence of 2 inches or more of rain within a 12-hour period.
 3. Any drought condition causing termination of irrigation by local jurisdiction.
 4. Winds or wind gusts in excess of 70 miles per hour as registered at a certified weather station in the local area.
 5. Snow fall in excess of 12 inches in a 24 hour period in the local area.
 6. The occurrence of freezing rain or "silver thaw" conditions, causing radial ice accumulation greater than ¼ inch thick.

PART 2 PRODUCTS

2.1 PLANT MATERIALS

A. Plant Names:

1. Plants shall be in accordance with the current issue of "Hortus Third" published by the MacMillan Co.
2. All groups of plants shall be tagged with an approved weatherproof tag, listing their botanical and common name. Ground covers shall be marked with an upright post type of marker. All plant groups of similar species or varieties shall have minimum one (1) label per group.
3. Trees shall be individually labeled.

B. Trees and Shrubs:

1. Trees: Straight trunks with leader intact, undamaged, and uncut. Rootball diameter shall be in accordance with ASNS.
2. Plant materials shall be sound, healthy, and vigorous; well-branched and densely foliated when in leaf; free from disease, insect pests, eggs, or larva and with healthy, well developed root systems.

C. Balled and Burlapped Stock:

1. Dig with firm, natural, balls of earth of sufficient diameter and depth to encompass fibrous and feeding root system.
 2. Wrap root balls firmly with burlap and bind with twine or wire mesh.
 3. Handle by the rootball only. Take care to protect rootball and plant. Cracked, broken or dry-to-center rootballs will not be accepted.
- D. Container Stock:
1. Grown in delivery containers for not less than six (6) months but not more than two (2) years.
 2. Root bound conditions and broken balls of earth will not be allowed. Do not handle by trunks, stems, or tops.
- E. Plants are subject to approval by the Owner and may be rejected at any time during progress of the work for size, condition of rootball, latent defects or injuries.

2.2 FERTILIZER

- A. Fertilizer: 16-16-16 or approved equal.

2.3 MULCH

- A. Mulch shall be coarse bark mulch consisting of Douglas fir or hemlock bark. It shall be uniform color and free from weed seeds, sawdust and splinters. Mulch shall not contain resin, tannin, wood fiber or other compounds detrimental to plant life. Desired particle size range is ½-inch to 2-inch. No more than 15 percent by volume shall pass through ½-inch screen. Minimum 95 percent shall pass through a 2-inch sieve. Preapproval inspection by Owner is required.

2.4 BIORETENTION AREA MULCH (MEDIUM COMPOST)

- A. Organic mulch in the bottom and sides of the bioretention areas shall consist of Medium Compost. Medium Compost shall meet the requirements for Compost in specification Section 32 91 13, article 2.2, except that the gradation shall be for medium rather than fine compost.

2.5 PLANTING ACCESSORIES

- A. Landscape Steel Metal Edging with Stakes
1. Steel Landscape Edging shall be an all-steel interlocking system, 1/8" thick, and 4" min. depth, in 16 to 20' long sections with 6 steel stakes per section, having a

powder coated brown finish. Supply adequate stakes for each section to be installed. Stakes shall be 15" long steel construction as manufactured by:

- a. Sure-loc Edging Corporation, 494 E. 64th Street, Holland, MI, 49423, Ph. 800-787-3562; or
- b. Border Concepts, P.O. Box 471185, Charlotte, NC, 28247, Ph: 704-541-5509; Collier Metal Specialties, Inc., Dallas Texas, Ph: 1-800-829-8225;
- c. or equal.

B. Tree Root Barrier

1. Root barrier shall be .08 inch thick by 18 inch deep, injection molded or extruded modular, interlocking reinforced polypropylene panels with vertical ribs for rigidity or approved equivalent.
2. Tensile strength to meet ASTM D638 2,300 psi minimum
3. Root barriers to be constructed of minimum 30 percent post-consumer recycled material

C. Tree stakes and guys

1. Stakes: 2-inch diameter untreated lodge pole pine or Douglas fir stake with chamfered tops.
2. Ties: Recycled polypropylene, chainlock guys.

PART 3 EXECUTION

3.1 INSPECTION

A. Inspection of Trees and Shrubs:

1. Inspection and acceptance of all plants, prior to planting, is mandatory and the Owner reserves the right to reject any or all plant material at any time until final inspection and acceptance. Plants shall be labeled at the time of inspection. Remove labels after acceptance and prior to final walk through.

3.2 PREPARATION

- A. The irrigation system shall be completed and tested prior to planting installation so that it is capable of keeping the site watered for planting and establishment.

3.3 INSTALLATION

- A. General: Notify the Owner of all subsurface drainage or soil conditions detrimental to growth or survival of plant material.
- B. Trees and Large Shrubs:
 - 1. Locations of all trees shall be inspected and accepted by the Owner prior to planting. Indicate the location of each tree with a 2-inch-square by 2-foot-long wood stake or wire stake with flag. Place large containerized or balled and burlapped shrubs in proposed locations for observation by Owner prior to planting. Begin planting after approval of locations by the Owner.
 - 2. Procedure for planting:
 - a. Prior to installation, check top of tree root ball for root flare. If no roots are found because the root flare is buried, scrape or cut away excess soil until root flare is exposed. This shall be the finish grade level referred to in the planting details.
 - b. Cleanly cut off all broken or frayed roots. Tease out existing roots on perimeter of rootball without disturbing structure of root ball. Cut all girdling roots. ANSI A300.
 - c. Roots of trees and shrubs shall be placed to have a natural spread and distribution in the planting pit.
 - d. For trees, apply fertilizer on surface at manufacturer's recommended rate for new installations.
 - e. For large shrubs, apply fertilizer on surface at manufacturer's recommended rate for new installations. Do not apply fertilizer in bioretention areas.
 - f. Add native soil to bottom of plant pit and tamp firmly to prevent settlement. Place plant in pit and remove binding of upper one-third of burlap and cut away upper one-third of burlap. Remove all plastic and all other non-biodegradable packaging.
 - g. Fill planting pit to two-thirds depth and tamp with foot. Flood holes with sufficient water to settle.
 - h. After surplus water drains off, fill hole to finish grade with backfill. Tamp soil firmly. Stake trees.
- C. Ground Cover and Small Shrubs:

1. Place plants per planting plan. Begin planting after approval of locations by Owner.
 - a. Clean areas of all extraneous material.
 - b. Dish out plant pockets in staggered rows. Set plants to grade. If on slope, lay plant at angle with slope before backfilling with amended soil.
 - c. Container grown stock; remove plants from containers prior to planting.
- D. Mulching:
 1. All beds shall have three (3) inch depth of Coarse Bark Mulch. Install three (3) inch depth Medium Compost mulch in bioretention areas instead of bark mulch.
- E. Pruning: Prune trees only to remove broken or damaged branches, or for aesthetic purposes as directed by the Owner. No branches shall be removed without prior approval from the Owner. Neither stubs nor flush cuts will be acceptable. Cuts to remove entire branches shall be just above and outside the branch collar and bark ridge.

3.4 PLANTING ACCESSORIES

- A. Examination: Verify installation conditions as satisfactory to commence work. Do not install until unsatisfactory conditions are corrected. It is the Contractor's responsibility to ensure all existing conditions are acceptable to proceed.
- B. General: Install all manufactured items in accordance with these specifications, contract drawings, and manufacturer's instructions. Where these may be in conflict, the more stringent requirements govern.
- C. Staking: Stake all deciduous and coniferous trees to stand plumb immediately after planting.
- D. Steel edging: The metal edging is to be installed between planting beds and gravel areas as shown on the drawings. Install landscape steel edge restraint per manufacturer's specifications and recommendations. Edging layout alignment shall be reviewed and approved by Owner prior to installing final stakes.
- E. Tree root barriers shall be installed per notes on drawings.

3.5 MAINTENANCE

- A. Maintain planting in a healthy growing condition acceptable to the Owner until final acceptance.

- B. Maintenance shall include cultivating, weeding, watering, and pruning (only as directed). Application of herbicides, pre-emergent herbicides, insecticides, or other toxic substances are not allowed for general weed and pest control. Use integrated pest management practices (IPM), using least toxic methods of control. If it is determined by a horticultural expert that disease or pest control chemicals are needed, secure Owner's written approval before application.
 - 1. Re-set settled plants to proper grade and position. Remove dead material.
 - 2. Straighten, repair, and adjust guy wires and stakes as required.
 - 3. Correct defective work as soon as possible after deficiencies become apparent and weather and season permit.
 - 4. Water trees, plants, and ground cover beds within the first 24 hours of initial planting, and not less than twice per week until final acceptance.

3.6 ADJUSTING AND CLEANING

- A. Maintain the Site in an orderly condition during the progress of Work. Continuously and promptly remove excess and waste materials; keep adjacent lawn areas, walks and roads clear; clean soil, mulch and stains from structures and building exterior. Store materials and equipment in accordance with manufacturer's recommendations. Immediately remove rejected materials from the property. Promptly remove equipment, surplus material, and debris and trash resulting from operations under this Contract upon completion and prior to initial acceptance of Work. Leave the Site in a neat, orderly condition, broom clean.
- B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors and trades and trespassers. Provide adequate and proper care of all plant material and work done and maintain protection until final acceptance. Adequate and proper care means keeping all plant material in a healthy, growing condition and includes removing the weeds, litter, and other debris along with retaining the finished grades in a neat uniform condition.

3.7 FINAL ACCEPTANCE

- A. Inspection to determine final acceptance of planted areas will be made by the Owner, upon Contractor's request. Provide notification at least ten (10) working days before requested inspection dates.
- B. Planted areas will be accepted provided all requirements have been complied with and plant materials are alive and in a healthy, vigorous condition.
- C. Upon successful completion of work, the Owner will notify the Contractor in writing of acceptance of the landscaping work and the beginning of the warranty period.

3.8 WARRANTY PERIOD

A. Duration of Warranty:

1. Plant materials shall be warranted for a period of one (1) year from the date of final acceptance.
2. Replace defective plant materials noted. Upon completion of replacements, final approval of all warranted plants will be verified in writing by the Owner.
3. All replacement plants shall have their warranty period extended for one (1) year from the date of replacement installation.

END OF SECTION

DIVISION 33 - UTILITIES

**SECTION 33 05 13
MANHOLES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes cast-in-place and precast concrete manholes and covers for access to subsurface drainage piping or utilities.

- B. Section Includes:
 - 1. Cast-in-place concrete manholes with transition to cover frame, covers, anchorage, and accessories.

 - 2. Modular precast concrete manhole with tongue-and-groove joints with precast transition to cover frame, covers, anchorage, and accessories.

 - 3. Bedding and cover materials.

- C. Related Sections:
 - 1. Section 03 11 00 - Concrete Work

 - 2. Section 03 20 00 – Concrete Reinforcement

 - 3. Section 31 05 13 - Soils for Earthwork

 - 4. Section 31 05 16 - Aggregates for Earthwork

 - 5. Section 31 23 16 - Excavation

 - 6. Section 31 23 23 - Fill

 - 7. Section 33 30 10.13 - Sewer and Manhole Testing

 - 8. Section 33 41 10 - Storm Utility Drainage Piping

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
 - 1. AASHTO M-198B – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

- B. American Concrete Institute (ACI):

1. ACI 301 – Building Code Requirements for Structural Concrete
 2. ACI 315 – Details and Detailing of Concrete Reinforcement
 3. ACI 318 – Building Code Requirements for Structural Concrete
- C. ASTM International (ASTM):
1. ASTM A48 - Standard Specification for Gray Iron Castings
 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 3. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
 4. ASTM C55 - Standard Specification for Concrete Building Brick
 5. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made from Clay or Shale)
 6. ASTM C150 - Specifications for Portland Cement
 7. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar
 8. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
 9. ASTM C478 - Standard Specification for Precast Reinforced Concrete Manhole Sections
 10. ASTM C497 - Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
 11. ASTM C827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures
 12. ASTM C913 - Standard Specification for Precast Concrete Stormwater and Wastewater Structures
 13. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals
 14. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
- D. Federal Specifications:

1. SS-S-00210 (210-A) – Specification for Sealing Compound, Preformed Plastic, for Expansion Joints and Pipe Joints
- E. US Army Corp of Engineers:
 1. CRD-C 621 – Specifications for Non-Shrink Grout
- F. City of Port Orchard:
 1. Public Works Engineering Standards and Specifications

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Pre-cast concrete manholes:
 - a. Design criteria and calculations.
 - b. Details of reinforcement.
 2. Steps.
 3. Cover and frame construction, features, configuration, dimensions, and material specifications.
 4. Rubber gaskets.
 5. Grout and mortar.
- C. Shop Drawings:
 1. Indicate manhole by location.
 2. Provide dimensions, elevations, joints, location, and type of lifting inserts.
 3. Indicate connecting piping material, piping size, piping connection angles and offsets, and sizes of penetrations.
- D. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.

- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- B. Comply with Precast Concrete Manufacturer's instructions and ASTM C913 for unloading, storing, and moving precast manholes and drainage structures.
- C. Storage:
 - 1. Store precast concrete manholes as to prevent damage to Owner's property or other public or private property.
 - 2. Repair property damaged from materials storage.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA FOR MANHOLES

- A. Equivalent strength: Based on structural design of reinforced concrete as outlined in ACI 318.
- B. Design of Lifting Devices for Precast Components: According to ASTM C913.
- C. Design of Joints for Precast Components:
 - 1. According to ASTM C913.
 - 2. Lipped male/female joints.
 - 3. Maximum Leakage: 0.025 gallons per hour per foot of joint at 3 feet of head.
- D. Shaft Construction:
 - 1. Reinforced concrete.
 - 2. Concentric with eccentric cone top section
 - 3. Sleeved to receive pipe connections.
- E. Wall Thickness:
 - 1. Minimum wall thickness shall be 5 inches.

2. Cones shall have the same wall thickness and reinforcement as riser sections.
- F. Shape: Cylindrical.
- G. Clear Inside Dimensions:
1. As indicated on Drawings.
 2. Sections shall consist of circular sections in standard nominal inside diameters of 48, 54, 60, 72, 84, 96, 108, 120, 132, or 144 inches.
- H. Design Depth:
1. As indicated on Drawings.
 2. Clear Cover Opening: As indicated on Drawings, minimum of 30 inches.
- I. Pipe Entry: Furnish openings as required and as indicated on the Drawings.
- J. Steps:
1. Rungs:
 - a. Material:
 - 1) Polypropylene encased steel manhole steps with non-slip surface conforming to ASTM D4101. Steel reinforcing shall be ½-inch minimum diameter ASTM A615, Grade 60.
 - 2) Knurled ¾-inch diameter 3106 stainless steel steps.
 2. Width: Minimum 11-3/4 inches.
 3. Spacing: 12 inches on center vertically.

2.2 MANHOLES

- A. Precast Concrete Manholes:
1. Sections:
 - a. Description: Reinforced precast concrete according to ASTM C478.
 - b. Gaskets: According to ASTM C443.
 - c. Heights: Multiples of 6 inches.
 2. Bases:

- a. Precast bases may be separate or integral with the riser section.
- b. All manholes shall be installed with a GU Manhole Base Liner, or equal, with a plastic invert and nonskid landing area embedded in concrete and O-ring gaskets for the sewer connection or approved equal. The liner shall have a 5 mm minimum thickness.

B. Joint Materials:

1. Mortar:

- a. Conform to ASTM C387.
- b. Admixtures
 - 1) Allowable, not exceeding the following percentages of weight of cement:
 - a) Hydrated lime, 10 percent
 - b) Diatomaceous earth or other inert materials, 5 percent
- c. Consistency: Shall be such that it will readily adhere to the precast concrete if using the standard tongue and groove type joint.
- d. Mortar not used within 30 minutes of initial mixing shall be discarded and not be used.

2. Non-Shrink Grout:

- a. Description: Non-metallic, cementitious, commercial grout exhibiting zero shrinkage per ASTM C827 and CRD-C-621.
- b. Manufacturers:
 - 1) Preco-Patch
 - 2) Sika 212
 - 3) Euco N-S
 - 4) Five-Star
 - 5) Approved equal

3. Grout shall not be amended with water after initial mixing.

4. Grout not used within 20 minutes of initial mixing shall be discarded and not be used.
5. Commercial Concrete Bonding Agent:
 - a. Non-shrink grout shall be placed or packed only with the use of an approved commercial concrete bonding agent applied to all cured concrete surfaces being grouted.
 - b. Bonding agent shall be compatible with the brand of grout used.
 - c. Water shall not be used as a substitute for the commercial bonding agent.
- C. Provide sewage and grease resistant confined rubber gaskets conforming to ASTM C443. All joints shall be grout/sealed on all interior surfaces with mortar.
- D. Reinforcement:
 1. Formed steel wire.

2.3 FRAMES AND COVERS

- A. Description:
 1. Construction: Ductile iron.
 2. Lid:
 - a. Machined flat bearing surface.
 - b. Removable.
 3. Cover Design: Closed.
 4. Live Load Rating: AASHTO H20 loading.
 5. Cover: "SEWER" in 3-inch raised letters.
 6. Coefficient of Friction on Outside Face: Minimum of 0.60.
 7. Manufacturer: Provide Rexus or East Jordan Works hinged manhole frame and lid.

2.4 RISER RINGS

- A. Description:
 1. Four inches to 6 inches Thick:

- a. Material: Precast concrete.
- b. Comply with ASTM C478.
2. Less than 4 inches Thick:
 - a. Material: HDPE.
 - b. Manufacturer: Ladtech or approved equal
3. Rubber Seal Wraps:
 - a. Wraps and Band Widths: Conform to ASTM C877, Type III.
 - b. Cone/Riser Ring Joint: Minimum 3 inches overlap.
 - c. Frame/Riser Ring Joint: 2 inches overlap.
 - d. Additional Bands: Overlap upper band by 2 inches.

2.5 MATERIALS

A. Bedding and Cover:

1. Bedding: Coarse Aggregate Material Type A2, Gravel Backfill, as specified in Section 31 05 16, Aggregates for Earthwork.
2. Backfill Around Structure: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork.
3. Soil Backfill from Above Pipe to Finish Grade:
 - a. In existing or future roadways, right-of-way:
 - 1) Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork.
 - b. In non-paved areas outside of footprint of existing or future structures, outside of right-of-way:
 - 1) Soil Type S1, as specified in Section 31 05 13, Soils for Earthwork.
 - 2) Subsoil: No rocks over 6 inches in diameter, frozen earth, or foreign matter.

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 excavation.

3.2 PREPARATION

- A. Design the method of placement for all precast items and add all reinforcing steel, embeds, bracing, and other items necessary for placement. All portions of embeds which remain embedded in the concrete shall be made of stainless steel.
- B. Mark each precast structure by indentation or waterproof paint showing date of manufacture, Manufacturer, and identifying symbols and numbers as indicated on Drawings to indicate its intended use.
- C. Coordinate placement of inlet and outlet pipe or duct sleeves required by other Sections.
- D. Do not install manholes where site conditions induce loads exceeding structural capacity of manhole components.
- E. 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.
- F. Subgrade
 - 1. Subgrade shall be compacted to 95 percent of maximum density.
 - 2. Compacted subgrade shall be covered with a minimum of 6 inches of aggregate base compacted to 95 percent of maximum density, extending a minimum of 6 inches beyond the outside limits of the manhole, unless otherwise indicated on Drawings.
 - 3. Grade the aggregate base to a uniform, level surface which will fully support the structure and to an elevation that will ensure proper positioning of the top slab or lid.

3.3 INSTALLATION

- A. Excavation and Backfill:

1. Excavate manholes as specified in Section 31 23 16, Excavation in location and to indicated depth.
 2. Provide 12 inches of clearance around sidewalls of structure for construction operations.
 3. When groundwater is encountered, prevent accumulation of water in excavations and place manholes in dry trench.
- B. Where possibility exists of watertight structure becoming buoyant in flooded excavation, anchor structure to avoid flotation as approved by Engineer.
- C. Base Pad:
1. Place base pad.
 2. Trowel top surface level.
- D. Backfill excavations for manholes as specified in Section 31 23 23, Fill.
- E. Form and place manhole cylinder plumb and level and to correct dimensions and elevations.
- F. Grout base of shaft sections to achieve slope to exit piping, trowel smooth, and contour to form continuous drainage channel.
- G. Set cover frames and covers level without tipping and to correct elevations.
- H. Coordinate with other Sections of Work to provide correct size, shape, and location.
- I. Precast Concrete Manholes:
1. Assembly:
 - a. Install precast structures in accordance with the Manufacturer's recommendations unless otherwise required by the Contract Documents.
 - b. Verify installed manholes meet required alignment and grade.
 - c. Lift precast components at lifting points designated by Manufacturer.
 - d. When lowering manholes into excavations and joining pipe to units, take precautions to ensure that interior of pipeline and structure remains clean.
 - e. Set precast structures bearing firmly and fully on crushed stone bedding, compacted as specified in Section 31 23 23, Fill or on other support system as indicated on Drawings.

- f. Assemble multi-section structures by lowering each section into excavation; set level and firmly position base section before placing additional sections.
 - g. Place manhole sections plumb and level, trim to correct elevations, and anchor to base pad.
 - h. Remove foreign materials from joint surfaces and verify sealing materials are placed properly.
 - i. Maintain alignment between sections by using guide devices affixed to lower section.
2. Joints:
- a. Sealing materials may be installed onsite or at Manufacturer's plant.
 - b. All joints shall be sealed watertight by the use of rubber gaskets or other approved preformed sealant.
 - c. All joints shall then be filled with non-shrink grout on both the inside and outside surfaces to produce smooth interior and exterior surfaces.
3. Concrete Base Installation:
- a. Bases shall be set at the proper grade to allow pipe openings to match the grades for connecting pipes.
 - b. Invert shall be constructed to a section identical with that of the sewer pipe.
 - c. Where the size of sewer pipe is changed at the manhole, the invert shall be constructed to form a smooth transition without abrupt breaks or unevenness of the invert surfaces.
 - d. Prevent sewage or water from contacting the new concrete or mortar surfaces to prevent damage to the fresh concrete or mortar until the initial set has been achieved.
 - e. Manhole bases shall be set level so base gravel fully and uniformly supports them in true alignment with uniform bearing throughout full circumference.
 - f. Do not level the base sections by wedging gravel, or other material, under the edges.
 - g. Flexible connectors shall be installed in the base section to form a permanently watertight seal.
4. Manhole Riser Sections:

- a. Precast manhole components may be used to construct standard, drop and carry-through manholes. Manholes less than 4 feet in depth measured from the spring line of the pipe to the bottom of the lower riser ring shall be flat-top manholes.
 - b. Install manhole riser sections at the location shown on the plans. All sanitary sewer and pollution control manholes joints shall be watertight and shall use rubber gaskets or a preformed sealant. All joints shall then be filled with non-shrink grout inside and out so as to produce smooth interior and exterior surfaces. All manhole penetrations shall be watertight. Complete manholes shall be rigid. Compact backfill in accordance with the provisions stated elsewhere in this document.
 - c. All lift holes shall be thoroughly wetted, completely filled with mortar, and smoothed and pointed both inside and out to ensure watertightness.
 - d. The shortest length of riser section to be incorporated into the manhole shall be installed immediately below the flat slab top or cone.
 - e. Properly locate and plumb each manhole riser section.
 - f. Install manhole extensions and top slabs in accordance with Manufacturer's specifications and as shown on the plans. Lay section risers with the sides plumb and the tops level. Make joints and penetrations watertight.
 - g. Remove knockouts or cut structure to receive piping without creating openings larger than required to receive pipe; fill annular spaces with mortar.
5. Entrances/Exits:
- a. Cut pipe flush with interior of structure.
 - b. Shape inverts through manhole as indicated on Drawings.
 - c. All rigid non-reinforced pipe entering or leaving the manhole (new or existing manhole) shall be provided with flexible joints within 1 foot of the structure and shall be placed on compacted bedding.
 - d. Ribbed HDPE pipe connections shall be grouted watertight with non-shrink grout.
 - e. PVC pipe shall be connected to manholes using an approved adapter specifically manufactured for the intended service.
 - 1) Adapters shall be Fernco, Kor-N-Seal, or equal.

6. Grates, Frames, and Covers:

- a. Manhole frames, grates, and covers shall be installed in such a manner as to prevent infiltration of surface or groundwater between the frame and the concrete of the manhole section. Use preformed rubber ring to form a watertight seal.
- b. Manhole frames and covers shall be installed to grades shown on the drawings or as directed.
- c. Adjustment of manhole castings shall be made using specified precast grade rings and approved rubber ring joints.
- d. The maximum depth of adjustment below any manhole casting shall be 16 inches, and a minimum depth of adjustment shall be 8 inches.

3.4 FIELD QUALITY CONTROL

- A. Test concrete manhole and structure sections according to ASTM C497.
- B. Perform manhole testing according to Section 33 30 10.13, Sewer and Manhole Testing.
- C. Vertical Adjustment of Existing Manholes:
 1. If required, adjust top elevation of existing manholes to finished grades as indicated on Drawings.
 2. Reset existing frames, grates, and covers that were carefully removed and cleaned of mortar fragments to required elevation according to requirements specified for installation of castings.
 3. When removal of existing concrete wall is required, remove concrete without damaging existing vertical reinforcing bars, clean concrete from vertical bars, and bend into new concrete top slab or splice to required vertical reinforcement as indicated on Drawings.

END OF SECTION

SECTION 33 05 17
PRECAST CONCRETE VALVE VAULTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast concrete valve vaults.

1.2 RELATED SECTIONS

- A. Section 05 50 00, Metal Fabrications.
- B. Section 31 05 16, Aggregates for Earthwork.
- C. Section 31 23 16, Excavation
- D. Section 31 23 23, Fill.
- E. Section 33 11 10, Water Utility Distribution Piping.

1.3 REFERENCE STANDARDS

A. ASTM International:

1. ASTM A48 - Standard Specification for Gray Iron Castings.
2. ASTM A1064 - Standard Specification for Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
3. ASTM A536 - Standard Specification for Ductile Iron Castings.
4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
5. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
6. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
7. ASTM C33 - Standard Specification for Concrete Aggregates.
8. ASTM C150 - Standard Specification for Portland Cement.

9. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
10. ASTM C890 - Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures.
11. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
12. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants.
13. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft³ (600 kN-m/m³)).
14. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
15. ASTM D4104 - Standard Test Method (Analytical Procedure) for Determining Transmissivity of Nonleaky Confined Aquifers by Overdamped Well Response to Instantaneous Change in Head (Slug Tests).
16. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).

1.4 COORDINATION

- A. Coordinate Work with utilities within construction area.
- B. Where drawings identify precast vaults by manufacturer and model number, this information is provided for dimensional information only. Provide precast items in accordance with the requirements of this Section.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on valve vaults.
- C. Design Calculations signed by a registered engineer
- D. Buoyancy calculations prepared in accordance with the project geotechnical report.
- E. Shop Drawings for Precast Concrete Valve Vaults:
 1. Indicate plan, location, and inverts of connecting piping.
 2. All interior and exterior dimensions.
 3. Location and type of lifting inserts, connection embeds and joints.

4. Details of reinforcement.
 5. Covers or hatches.
 6. Ladders and grating.
- F. Manufacturer's Certificate: Certify that precast concrete valve vaults meet or exceed ASTM standards and specified requirements.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations and inverts of buried pipe, components, and connections.

1.7 QUALITY ASSURANCE

- A. Perform Work according to standards identified in Article 1.2 herein.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Transport and handle precast concrete units with equipment designed to protect units from damage.
- C. Storage:
1. Store precast concrete valve vaults according to manufacturer instructions.
 2. Do not place concrete units in position to cause overstress, warping, or twisting.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Performance and Design Criteria:
1. Watertight, Precast, Reinforced, Air-Entrained Concrete Structures:
 - a. Manufactured to conform to ASTM C913.
 2. Loading:
 - a. Design to AASHTO H-30 live loading and installation conditions.

- b. Where vaults are below grade, a dead load of 125 pounds per cubic foot shall be added for the soil.
- c. Lateral loads:
 - 1) 105 x Depth of fill (psf) triangular equivalent fluid pressure plus a surcharge of an additional three (3) feet of soil depth in areas subject to vehicular traffic (assume traffic load in all areas, unless indicated otherwise by the Contract Documents).
 - 2) Seismic acceleration: UBC Zone 3 requirements ($I = 1.25$) where I = importance factor, $I = 1.25$, but not less than 0.20 g acting on structure mass. Seismic loading need not be considered simultaneously with traffic surcharge.
- 3. Minimum 28-Day Compressive Strength: 5,000 psi
- 4. Honeycombed or retempered concrete is not permitted.
- 5. No block-outs or knockouts shall be cast into vault walls. All pipe penetrations shall be pre-formed or core-drilled at the required locations.
- 6. Accessories: Accessories such as ladders, floor grates at sumps, and other features shall be provided as shown on the Drawings.
- 7. Size: Vault dimensions shall be as required by the Drawings.
- 8. Provide vaults without vertical joints unless manufacturer's standard forms are not suitable for the design conditions. Panel vaults may be substituted as necessary.
- 9. Provide additional concrete or extended base slab to ensure vaults do not float when groundwater is at ground surface.

2.2 PRECAST CONCRETE VALVE VAULTS

A. Manufacturers:

- 1. Oldcastle
- 2. H2 Precast

B. Valve Vault Frames and Covers:

- 1. Cast Iron Castings:
 - a. ASTM A48, Class 30 or better.
 - b. Free of bubbles, sand, air holes, and other imperfections.

- C. Access Steps:
 - 1. Steel reinforced formed polypropylene:
 - a. ASTM C478.
 - b. Reinforced rod: ASTM A615, Grade 60, 1/2-inch diameter.
 - 2. Aluminum: ASTM B221, Alloy 6061-T6.
 - 3. Width: Minimum 12 inches.
 - 4. Spacing: 12 inches o.c. vertically.

2.3 ACCESS HATCHES AND LIDS

- A. Unless noted otherwise elsewhere in the Contract Documents, vaults shall have concrete top slabs with access openings as shown on the Drawings.
- B. Vault manufacturer shall provide the access hatches as shown on the drawings and constructed per the requirements of Section 05 50 00, Metal Fabrications.
- C. Lids shall have lifting accessories.
- D. When leveling bolts are used to set the vault top sections, ensure the load from the top slab is transferred through grout to the vault walls so that the load is not carried by the leveling bolts.

2.4 MATERIALS

- A. Furnish materials according to City standards and as shown in the details of the Drawings.
- B. Portland Cement:
 - 1. ASTM C150, Type II.
- C. Coarse Aggregates:
 - 1. ASTM C33.
 - 2. Graded 3/4 inch to No. 4 sieve.
- D. Sand:
 - 1. ASTM C33.
- E. Water:

1. Potable.
 2. Clean and free of injurious amounts of acids, alkalis, salts, organic materials, and substances incompatible with concrete or steel.
- F. Air-Entraining Admixtures: ASTM C260.
- G. Reinforcing Steel:
1. Deformed Bars: ASTM A615, Grade 60 minimum.
 2. Welded Wire Fabric: ASTM A1064.
- H. Gaskets:
1. Rubber gaskets: ASTM C443.
- I. Joint Sealant:
1. ASTM C990.
- J. Adhesive Waterstop:
1. HF-302 Hydro-Flex Waterstop, by Henry, or equal.
- K. Waterproofing:
1. Masonry waterproofing paint, Damplock by Seal-Krete, or equal.
- L. Bedding:
1. Aggregate Bedding Material: Crushed Surfacing Base Course per WSDOT Standard Specifications Section 9-03.9(3).

2.5 FABRICATION, GENERAL

- A. Fabricate precast reinforced concrete structures according to ASTM C913, to dimensions indicated on Drawings, and to specified design criteria.
- B. Vaults may be formed with separate top and bottom slabs.
- C. Horizontal joints may be provided so that walls can be placed in horizontal segments.
- D. All horizontal joints shall be keyed to prevent offsets and shall be provided with a watertight gasket/waterstop.
- E. Finish:

1. Formed surfaces shall be smooth and uniform with no fins, bulges, or other irregularities.
2. Any void greater in width than 1/2-inch or deeper than 3/8-inch shall be repaired.
3. Unformed interior slab surfaces shall have a smooth steel trowel finish.
4. Unformed exterior slab surfaces shall have a light broom finish applied to a steel trowel finish.

2.6 FABRICATION (FOR VAULTS WITHOUT VERTICAL JOINTS)

- A. Base and lower section of walls shall be cast as one watertight piece at the precast manufacturer's facility.
- B. Walls shall be cast so that all sides are continuous at corners and their full length with no block-outs or knockouts.
- C. Horizontal joints may be provided so that walls can be placed in horizontal segments.

2.7 FABRICATION (FOR PANEL VAULTS)

- A. Horizontal and vertical joints may be provided so that walls and top and bottom slabs can be placed in sections.
- B. Separate sections shall be connected using mechanical connectors specifically designed for the application.
- C. Vertical joints shall be provided with watertight gasket or adhesive waterstop.

2.8 MIXES

- A. Design concrete mix to produce required concrete strength, air-entrainment, watertight properties, and project requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping connections, sizes, locations, and inverts are as indicated on Drawings.

3.2 PREPARATION

- A. Remove scale and dirt from components before assembly.
- B. Establish invert elevations for each component in system.

- C. Hand trim excavation to suit valve vaults; remove stones, roots, and other obstructions.

3.3 INSTALLATION

A. Vaults and Bedding:

1. Hand trim excavation for accurate placement of vaults to elevations indicated.
2. Place bedding material level in one continuous layer to a minimum compacted depth of 12 inches.
3. Compact bedding material to 95 percent maximum density.
4. Bases for precast concrete structures shall be set level so that bedding material fully and uniformly supports them in true alignment with uniform bearing throughout full perimeter. Do not level bases by wedging gravel under the edges.
5. Apply waterproofing paint to the interior of the vault in accordance with manufacturer's recommendations.
6. Backfill around sides of vaults as required by City Standard Specifications, Section 7.6.

B. Connect piping.

3.4 FIELD QUALITY CONTROL

- A. Request examination of subgrade by Engineer prior to placing aggregate base under precast materials.
- B. Compaction Testing: In accordance with Section 2-03.3(14)D of the WSDOT Standard Specifications
- C. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.
- D. Frequency of Compaction Tests: In accordance with Section 01 45 00, Quality Control.

END OF SECTION

**SECTION 33 05 50
EXISTING PIPE ABANDONMENT**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the removal of existing buried piping and abandonment in place of existing buried piping.
- B. Section includes:
 - 1. Pipe removal.
 - 2. In-place abandonment of pipe.
- C. Related Sections:
 - 1. Section 03 62 00, Non-Shrink Grout.
 - 2. Section 31 23 16, Excavation.
 - 3. Section 31 23 17, Trenching.
 - 4. Section 31 23 19, Dewatering.
 - 5. Section 31 23 23, Fill.
 - 6. Section 31 23 24, Flowable Fill.

1.2 SUBMITTALS

- A. Provide all submittals in accordance with Section 01 33 00, Submittal Procedures.
- B. Piping Abandonment Plan:
 - 1. Identify locations specified for pipe abandonment.
 - 2. Provide method to be utilized to abandon the pipe, including whether the pipe will be left in place or removed in its entirety.
- C. Non-Shrink Grout: Product data in accordance with Section 03 62 00, Grouting.
- D. CLSM: Mix designs in accordance with Submittal requirements of Section 31 23 24, Flowable Fill.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- A. Permits: The Contractor is responsible for obtaining all necessary permits required for completion of the work described herein.
- B. Protection of Persons and Property: Meet all federal, state, and local safety requirements for the protection of workmen, other persons, and property in the vicinity of the work and requirements of the General Provisions.

1.4 PROTECTION OF EXISTING WORK

- A. Carefully examine the Contract Documents to determine the extent of the work of this Section.
- B. Carefully coordinate the work of this Section with all other work and construction.
- C. Take all necessary precautions to prevent damage to existing facilities or utilities which are to remain in place and be responsible for any damages to existing facilities or utilities, which are caused by the operations.

1.5 REPAIR OF DAMAGE

- A. Work procedures shall provide for safe conduct of the work; careful removal and disposition of materials and equipment; protection of facilities, utilities and property which are to remain undisturbed; coordination with existing facilities and utilities to remain in service.
- B. Any damage to existing facilities or utilities to remain as caused by the Contractor's operations shall be repaired to acceptance of Engineer.
- C. Damaged items shall be repaired or replaced with new materials as required to restore damaged items or surfaces to a condition equal to and matching that existing prior to damage or start of work of this contract.

1.6 EXISTING CONDITIONS

- A. If the pipe material contains any hazardous materials, such as asbestos, requiring special handling upon removal, it is the responsibility of the Contractor to remove and dispose of the material in accordance with all applicable federal, state, and local regulations.

PART 2 PRODUCTS

2.1 OWNERSHIP OF EXISTING MATERIALS

- A. All materials, equipment, miscellaneous items, and debris involved, occurring, or resulting from pipe removal work shall become the property of the Contractor at the place of origin, unless otherwise specified in the Drawings or by the Engineer.

2.2 CONTROLLED LOW STRENGTH MATERIAL

- A. As specified in Section 31 23 24, Flowable Fill.

PART 3 EXECUTION

3.1 PIPE REMOVAL

- A. Where identified on the Drawings, remove, and dispose of all pipe material and associated appurtenances.
 - 1. All fire hydrants, air release valves service lines and appurtenances being abandoned shall be removed to 36 inches below finished grade.
 - 2. Existing service line appurtenances, including valve and meter boxes, shall be removed to 36 inches below finished grade.
- B. All exposed ends of pipes and fittings to remain in service shall be capped or plugged with an appropriate ductile iron blind flange, cap or plug and restrained.
 - 1. A pipe shall be considered in service if it is possible to flood the pipe with water by opening valves in the water system.
- C. All excavation and backfilling associated with pipe removal shall be performed in accordance with 31 23 17, Trenching.

3.2 IN-PLACE ABANDONMENT OF PIPING

- A. Where identified on the Drawings, abandon pipe in place.
- B. All exposed ends of pipes being abandoned in place shall be cut and plugged with a minimum of two (2) feet of non-shrink grout.
- C. Prior to placing grout, roughen interior pipe surface and apply epoxy bonding agent.

3.3 FILLING PIPE WITH CLSM

- A. Where identified on the Plans, pipes greater than 12 inches in diameter to be abandoned-in-place shall be filled with CLSM.
- B. CLSM shall be placed in a manner to ensure complete filling of the pipe, leaving no cavities or voids.
- C. Install hot taps, saddles, fill lines and appurtenances as necessary for pumping CLSM from the surface into the pipe being filled.
- D. CLSM shall be pumped up grade from fill lines rigidly connected to the pipes being filled.
- E. Placement of CLSM by free flowing (non-pumped) methods will not be acceptable.
- F. Fill lines shall be located at elevations lower than the pipe being filled.
- G. As the CLSM is being placed, use other fill lines as view ports to ensure complete filling of the pipes.
- H. Relocate pumping equipment as necessary to complete filling of the pipes.
- I. Excavate and cut access holes in the pipes as necessary to complete filling operations.
- J. Perform pipe filling operations in a manner to eliminate all air pockets.
- K. Submit volume calculations for CLSM placed in each filled segment of piping to verify that pipelines have been completely filled.

3.4 CLEANUP

- A. During and upon completion of work of this Section, promptly remove all unused tools and equipment, surplus materials, and debris.
- B. Adjacent areas shall be returned to their existing condition prior to the start of work.

END OF SECTION

SECTION 33 11 10
WATER UTILITY DISTRIBUTION AND TRANSMISSION PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Work under this Section applies to furnishing and installation of pipe materials, fittings, and appurtenances normally encountered with water distribution and transmission systems, including potable water and fire water systems.

- B. Section includes:
 - 1. Pipe and fittings
 - 2. Flexible couplings
 - 3. Flanged coupling adapters
 - 4. Insulating flanged joints
 - 5. Tapping sleeves and valves
 - 6. Flexible expansion joints
 - 7. Bedding and cover materials
 - 8. Geomembrane for gas line crossings

- C. Related Requirements:
 - 1. General
 - a. Furnish and install all piping systems shown and specified in accordance with the requirements of the Contract Documents.
 - b. Each buried piping system shall be complete, with all necessary fittings, valves, accessories, lining and coating, testing, excavation, backfill and encasement, to provide a functional installation.
 - c. Piping layouts shown in the Drawings are intended to define the general layout, configuration, and routing for pipe, as well as the size and type of piping to be installed. The piping plans are not pipe construction or fabrication drawings.
 - d. The Contractor shall cause the Supplier of pipes, valves, fittings, and appurtenances to coordinate piping installation such that all equipment is

compatible and is capable of achieving the performance requirements specified in the Contract Documents.

- e. It is the Contractor's responsibility to develop the details necessary to construct all piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, valves, gaskets, fittings, appurtenances etc., for a complete and functional system.

D. Related Sections:

1. Section 03 11 00 - Concrete Work
2. Section 31 05 13 - Soils for Earthwork
3. Section 31 05 16 - Aggregates for Earthwork
4. Section 31 23 16 - Excavation
5. Section 31 23 17 - Trenching
6. Section 31 23 23 - Fill
7. Section 31 23 24 - Flowable Fill
8. Section 33 05 17 - Precast Concrete Valve Vaults
9. Section 33 12 16 - Water Utility Distribution and Transmission Valves
10. Section 33 13 00 - Testing and Disinfecting of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop

B. American Society of Mechanical Engineers (ASME):

1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
3. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges
4. ASME B31.10 - Standards of Pressure Piping

C. ASTM International (ASTM):

1. ASTM A36 - Standard Specification for Carbon Structural Steel
2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
3. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
4. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
5. ASTM A536, Standard Specification for Ductile Iron Castings.
6. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
7. ASTM D1598 - Standard Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
8. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
9. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
10. ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
11. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
13. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

D. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings

4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
 5. AWWA C115 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
 6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast
 7. AWWA C153 - Ductile-Iron Compact Fittings
 8. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe
 9. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 10. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
 11. AWWA C606 - Grooved and Shouldered Joints
 12. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm), for Water Transmission and Distribution
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
1. MSS SP-60 - Connecting Flange Joints between Tapping Sleeves and Tapping Valves
- F. NSF International (NSF):
1. NSF Standard 61 - Drinking Water System Components – Health Effects
 2. NSF Standard 372 - Drinking Water System Components – Lead Content
 3. NSF 600 – Health Effects Evaluation and Criteria for Chemicals in Drinking Water
- G. SUBMITTALS
- H. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- I. Product Data: Submit data on pipe materials, pipe fittings, restrained joint systems, and accessories.
- J. Shop Drawings: Indicate piping layout, including piping specialties.
1. Layout Schedule for applicable segments of proposed transmission main alignment. Schedule shall include layout plan and dimensions, schedule of pipe fittings and specials, materials and class for each size and type of pipe, joint details, pipe supports, and any special provisions required for assembly.

- K. Lining and coating data.
- L. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- M. Manufacturer's handling, delivery, storage, and installation requirements.
- N. Field Quality-Control Submittals:
 - 1. Pipeline hydrostatic testing plan.
 - 2. Indicate results of Contractor-furnished tests and inspections.
- O. Preconstruction Photographs:
 - 1. Submit digital files of colored photographs of Work areas and material storage areas.

1.3 CLOSEOUT SUBMITTALS

- A. As-Built Drawings:
 - 1. Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.4 QUALITY ASSURANCE

- A. Materials:
 - 1. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
 - 2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.
 - 3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.
 - 4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.
- B. Markings:

1. Pipes and Fittings: Mark each pipe and fitting at plant. Include date of manufacture, Manufacturer's identification, specification standard, inside diameter of pipe, dimension ratio as applicable, pipe class as applicable, pipe number for laying purposes as applicable, and other information required for type of pipe.
 2. Bolting materials (washers, nuts, and bolts) shall be marked with material type.
- C. Testing:
1. Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards.

1.5 MATERIAL DELIVERY, STORAGE, AND HANDLING

- A. In accordance with Manufacturer's written recommendations and as specified in these Contract Documents.
- B. Pipe, specials, and fittings delivered to Project Site in damaged condition will not be accepted.
- C. Storage:
1. Store and support pipe securely to prevent accidental rolling and to avoid contact with mud, water, or other deleterious materials.
 2. Pipe and fittings shall not be stored on rocks, gravel, or other hard material that might damage pipe. This includes storage area and along pipe trench.
 3. Do not store materials in direct sunlight.
 4. Gaskets: Do not allow contact with oils, fuels, petroleum, or solvents.
- D. Handling:
1. Pipe and appurtenances shall be handled in accordance with Manufacturer's recommendations or requirements contained in this section or subsequent sections dealing with the specific pipe material, whichever is more stringent.
 2. Pipe shall be handled with proper equipment in a manner to prevent distortion or damage. Use of hooks, chains, wire ropes, or clamps that could damage pipe, damage coating or lining, or kink and bend pipe ends is not permitted.
 3. Use heavy canvas, or nylon slings of suitable strength for lifting and supporting materials.
 4. Lifting pipe during unloading or lifting into trench shall be done using two slings placed at quarter point of pipe section. Pipe may be lifted using one sling near

center of pipe, provided pipe is guided to prevent uncontrolled swinging and no damage will result to pipe or harm to workers. Slings shall bear uniformly against pipe.

E. Pipe Plugs:

Provide and install a cap or plug on each end of pipe during transportation and onsite storage to protect linings and coatings from debris. Install watertight plug-in end of installed pipe at the end of the workday. Under no circumstances shall materials be dropped or dumped into the trench.

PART 2 PRODUCTS

2.1 WATER PIPING

A. General

1. All piping materials and specials shall meet the specifications of this Section and of the appropriate AWWA Standard Specifications. In the case of conflict, the more stringent specifications shall apply.
2. All coatings and materials specified herein which may come in contact with potable water shall conform to National Sanitation Foundation (NSF) Standard 61, 372 and 600.
3. Minimum Pressure Ratings: Unless otherwise specified herein or shown in the Drawings, the minimum working pressure rating of all water works materials specified herein shall be 1-1/2 times the operating pressure or 150 pounds per square inch (psi) minimum.
4. Gaskets:
 - a. Material: Styrene Butadiene Rubber (SBR) composition.

B. Ductile Iron Pipe:

1. Centrifugally cast, conforming to AWWA Standard C151.
2. Coating: Asphaltic exterior coating in accordance with AWWA Standard C151.
3. Pipe Mortar Lining: Shop-applied NSF 61 cement mortar lining, smoothed finish, complying with AWWA C104.
4. Pipe Thickness Class:
 - a. Comply with AWWA C151.

- b. Class 52, unless shown to be greater in the Plans.
 - 1) The Contractor shall be aware ductile iron piping with thickness class greater than Class 52 may have long fabrication and supplier lead times. The Contractor shall be responsible for coordinating product submittal and delivery times accordingly such as not to delay construction.
- 5. Polyethylene Encasement:
 - a. Comply with AWWA C105.
 - b. Polyethylene film shall be minimum 8-mil thick virgin linear low-density polyethylene (LLDPE).
 - c. Secure in place with 10-mil polyethylene tape
 - d. V-BIO Enhance Polyethylene Film shall be minimum 9-mil thick and provided where specified or shown on plans.
- 6. Joints:
 - a. Joint types shall be provided as identified in the Drawings and as required for the application.
 - b. Mechanical Joints:
 - 1) Comply with AWWA C111.
 - c. Push-on Joints:
 - 1) Comply with AWWA C111.
 - 2) Manufacturers, without exception:
 - a) Tyton Joint by American Cast Iron Pipe Company, U.S. Pipe and Foundry Company, McWane, and Pacific States Cast Iron Pipe.
 - b) Fastite Joint by American Cast Iron Pipe Company.
 - d. Restrained Joints:
 - 1) Joint restraint for pipe shall be accomplished with an integral lock mechanism, except as may be otherwise specified.
 - a) Any such system shall be a manufacturer's standard proprietary design, shall be as recommended by the Manufacturer for the application, and shall be performance proven.

- 2) Restraining components:
 - a) Ductile iron complying with AWWA C110 and/or C153, with the exception of a manufacturer's proprietary design dimensions.
 - b) Push-on joints for such fittings shall comply with AWWA C111.
- 3) Deflection:
 - a) The maximum pipe deflection shall not exceed one-half of the Manufacturer's stated joint deflection allowance.
- 4) Manufacturers:
 - a) For pipe larger than 12"
 - (1) "TR Flex", United States Pipe and Foundry Company.
 - (2) "Flex-Ring", American Cast Iron Pipe Company.
 - b) For pipe 12" and smaller
 - (1) "Field-Lok", United States Pipe and Foundry Company.
 - (2) "Fast Grip", American Cast Iron Pipe Company.
 - (3) "TR Flex", United States Pipe and Foundry Company.
 - (4) "Flex-Ring", American Cast Iron Pipe Company.
 - c) For all pipe sizes
 - (1) Wedge-type Restraint System – "MEGALUG", EBBA Iron, Inc. or equal.
 - (a) Where any restrained joint system requires the use of a wedge-type mechanical restraint gland for restraint, the glands shall be provided in quantities as may be required and shall be considered incidental to the joint restraint system.
 - (b) Wedge-type mechanical restraining glands shall not be used to restrain the plain end of plain end ductile iron or cast-iron fittings.
- 5) "Foster Adaptor", Infact Corporation

- a) Where specified, mechanical joint (MJ) valves and fittings shall be connected using a bolt-through positive restraint mechanism manufactured of ductile iron conforming to ASTM A536, 65-45-12.
 - b) The positive restraint device shall connect the valves and/or fittings at a linear distance not to exceed three (3) inches and without attachment to pipe.
 - c) The device shall come complete with all accessories, including standard styrene butadiene rubber (SBR) MJ gaskets conforming to the latest revision of AWWA C111/ASTM F-477 and weathering steel (Corten) bolts conforming to AWWA C111/A21.11 and ASTM A242.
 - d) Nuts for 3 through 12-inch sizes shall be SAE Grade 5 steel with black oxide coating. Nuts for 14-inch and larger adaptors shall be heavy hex Corten steel conforming to ASTM A242.
 - e) MJ positive restraining device shall be supplied with NSF 61, 7-mil. fusion bonded epoxy conforming to AWWA C116/A21.16-09 as well as the coating, surface preparation and application requirements of ANSI/AWWA C550.
 - f) The device shall be used with standard mechanical joint fittings (AWWA C110 or C153) and valves and shall be Infact Corporation FOSTER ADAPTOR or equal.
- e. Flanged Joints:
- 1) Flat faced, complying with AWWA C111 and C115, unless otherwise specified.
 - 2) Bolt hole drilling according to ASME/ANSI B16.1, Class 125, or ASME/ANSI B16.1, Class 250, where specified. Flanges shall be attached with bolt holes straddling the vertical axis of the pipe unless otherwise shown.
 - 3) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain mating pipe, valve, and fitting flanges match in bolt pattern.
 - 4) Pressure rating of flange joints shall not exceed the rating of the pipe or fitting of which they are a part, and the maximum pressure rating of the joint shall be 250 psi.
 - 5) Flange joint connections shall not be exposed to test pressures greater than 1-1/2 times their rated working pressure.
 - 6) Threaded flanges:

- a) Ductile iron pipe spools with threaded flanges shall conform to AWWA C115.
 - b) Installed only on pipe with a minimum Class 53 wall thickness.
- 7) Buried flanges:
- a) Flanged connections shall not be buried unless shown as such on the Drawings.
 - b) Buried flanges shall be wrapped with 2 layers of 10-mil tape along edges of flanges.
- 8) Gaskets:
- a) Full faced, composed of synthetic rubber and 1/8-inch-thick conforming to ASME B21.1 and AWWA C111.
 - b) Ring gaskets will be permitted only where specifically noted in the Drawings and Specifications.
 - c) Gaskets for flanged joints shall be as follows:
 - (1) Pipe sizes between 6-inch and 24-inch diameter, service pressures of 150 psi or greater shall be Garlock 3760-U or equal.
 - (2) Pipe sizes 4-inch diameter and under, service pressures of 150 psi or greater shall be Garlock Linebacker or equal.
 - (3) All pipe sizes with service pressures of 150 psi or less shall be Garlock 98206 or equal.
 - d) Gaskets for insulating flanged joints shall be as follows:
 - (1) Full faced, conform to ANSI 16.21.
 - (2) Material: Non-asbestos.
 - (3) Suitable for operating and test pressures of the pipe system.
 - (4) Manufacturer:
 - (a) Garlock PSI Linebacker—manufactured by GPT-or equal.

2.2 FITTINGS

- A. Material: Ductile iron, complying with AWWA Standard C110.

1. Fittings conforming to AWWA C153 may be substituted in lieu of AWWA C110 fittings.
- B. Fittings used for joining ductile iron and PVC pipe shall be of the type, size, and strength designated on the Plans, elsewhere in the specifications.
 1. Fittings shall be mechanical joint, push-on type, flanged or plain-end as required and shown on the Drawings.
 2. All restraint systems and flanged fittings shall be provided with bolts and gaskets as specified herein.
- C. Pressure ratings: As specified for joining pipe above and as shown on the Drawings.
- D. Coating and Lining:
 1. Asphaltic exterior coating in accordance with AWWA Standard C110.
 2. Cement Mortar Lining: Comply with AWWA C104.
- E. Following information cast upon fittings:
 1. Manufacturer's identification.
 2. Country of manufacture.
 3. Pressure rating.
 4. For bends, number of degrees and/or fractions of a circle.
- F. Owner may require additional metallurgical documentation or other certifications.

2.3 NUTS, BOLTS, AND WASHERS

- A. All bolts shall have heavy hex head with heavy hex nuts.
- B. For operating pressures greater than 150 psi:
 1. Bolts: Steel alloy composition. Comply with ASTM A193.
 2. Nuts: Comply with ASTM A194, Grade 2H.
 3. Washers: Comply with ASTM F436.
- C. For operation pressures of 150 psi or less:
 1. Bolts: Low-carbon steel composition. Comply with ASTM A307, Grade B.

2. Nuts: Comply with ASTM A563A, Heavy Hex.
 3. Washers: Comply with ASTM F844.
- D. Higher-strength bolts with higher torque values as specified above for operation pressures greater than 150 psi shall not be used for assembly of flange joints including gray-iron flanges.

2.4 FLEXIBLE COUPLINGS

A. General

1. All flexible couplings shall be constructed to inside diameters that properly fit the connecting pipes.
2. The Contractor shall be responsible for selecting sleeve lengths appropriate to the application, subject to review and approval of the Engineer, recognizing that longer sleeves allow for larger deflections and may ease installation.

B. Flexible Couplings:

1. Description:

- a. Comply with AWWA C219.
- b. Type: Bolted, sleeved.
- c. Configuration: Straight, transition, or reducing as shown in the Drawings.
- d. Center rings and end rings: Ductile iron. Comply with ASTM A536.
- e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
- f. Bolts and nuts: High strength low alloy steel. Comply with AWWA C111.
- g. Lining and coating: Factory-applied fusion bonded epoxy.
- h. Working pressure: Up to 260 psi.

2. Manufacturers:

- a. Smith Blair
- b. Romac

C. Insulating Flexible Couplings:

1. The Contractor shall be responsible for selecting couplings appropriate to the application, subject to review and approval of the Engineer, recognizing that different pipe materials will require specific sizing and material selection for couplings.
 2. Description:
 - a. Comply with Flexible Coupling specifications above.
 - b. Insulating Boot: Ethylene propylene diene monomer (EPDM) compounded for water service. Comply with ASTM D2000.
 3. Manufacturers:
 - a. For 4-inch to 14-inch diameter:
 - 1) Romac Industries, Inc. – Style IC501 or equal.
 - b. For 12-inch to 96-inch diameter:
 - 1) Romac Industries, Inc. – Style IC400 or equal.
- D. Restrained Flexible Couplings:
1. Description:
 - a. Body: Steel. Comply with ASTM A36.
 - b. Restrained gland: Ductile iron. Comply with ASTM A536, Grade 65-45-12.
 - c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
 - d. Bolts and nuts: All-thread rod, at a minimum complying with ASTM A193 Grade B7. Nuts per ASTM A194 Grade 2H.
 - e. Lining and coating: Factory-applied fusion bonded epoxy.
 - f. Working pressure: 250 psi. Test pressure: 400 psi.
 2. Manufacturers:
 - a. EBAA Iron – 3800 MEGA-COUPLING

2.5 FLANGED COUPLING ADAPTERS

- A. Flanged Coupling Adapters:

1. All flanged coupling adapters shall be constructed to diameters that properly fit the connecting plain end pipe and the flanged fitting.
2. Description:
 - a. Comply with AWWA C219.
 - b. Flange: AWWA Class E Steel Ring Flange, compatible with ANSI Class 125 and 150 bolt circles.
 - c. End ring and body:
 - 1) Steel. Comply with ASTM A36.
 - 2) Ductile iron. Comply with ASTM A536, Grade 65-45-12.
 - d. Flange: Compatible with ANSI Class 125 and 150 bolt circles.
 - e. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
 - f. Bolts and nuts: High strength low alloy steel bolts and nuts. Comply with AWWA C111 composition requirements.
 - g. Lining and coating: Factory-applied fusion bonded epoxy.
 - h. Working pressure rating: Equal to the maximum rating of the flange.
3. Manufacturers:
 - a. Romac Industries, Inc.
 - 1) Style FCA501
 - a) For 3-inch to 16-inch diameter.
 - 2) Style FC400.
 - b. For 12-inch to 96-inch diameter.

B. Restrained Flanged Coupling Adapters:

1. Description:
 - a. Gland and flange body: Ductile iron. Comply with ASTM A536.
 - b. Flange: Compatible with ANSI Class 125 and 150 bolt circles.

- c. Gaskets: Virgin styrene butadiene rubber (SBR) compounded for water service. Comply with ASTM D2000.
 - d. Restraining bolts and lugs: Ductile iron. Comply with ASTM A536.
 - e. T-bolts, Bolts, and nuts: High strength low alloy steel. Comply with AWWA C111 composition requirements.
 - f. Lining and coating: Factory-applied fusion bonded epoxy.
2. Manufacturers:
- a. Romac Industries, Inc. – RFCA Restrained Flanged Coupling Adapters.
 - b. EBAA Iron – MEGAFLANGE Restrained Flange Adapter.

2.6 TAPPING SLEEVES AND VALVES

A. Tapping Sleeves:

1. Description:

- a. Type: Dual compression.
- b. Material:
 - 1) Body: Stainless steel, Type 304.
 - 2) Flanged outlet: Stainless steel, Type 304.
- c. Outlet Flange Dimensions and Drilling: Comply with ASME B16.1, Class 150, and MSS SP-60.
- d. Outlet Gasket:
- e. Provide with Type 304 stainless steel test plug.
- f. Nuts, bolts, and washers: Stainless steel, Type 304.

2. Manufacturers:

- a. Romac Style SST
- b. Ford Style FAST
- c. Approved equal

B. Tapping Valves:

1. Resilient wedge gate valves specified in Section 40 05 51.15, Gate Valves.

2.7 FLEXIBLE EXPANSION JOINTS

A. Description

1. Installed at locations indicated in the Drawings.
2. End connections: As shown in the Drawings.
3. Material: Ductile iron, AWWA C153.
4. Working pressure: 350 psi, minimum.
5. Construction:
 - a. An expansion joint designed and cast as an integral part of a double ball and socket type flexible joint.
 - b. Manufactured of ductile iron, conforming to requirements of AWWA C153 and ASTM A536.
 - c. Deflection: Minimum of 15 degrees deflection per ball.
 - d. Expansion:
 - 1) 12-inch diameter and under: 8-inch.
 - 2) Greater than 12-inch diameter: 16 inches.
 - e. Each flexible expansion joint shall be hydrostatically tested to the Manufacturer's published pressure rating prior to shipment.
 - f. Lining: All interior "wetted" parts shall be shop-lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be holiday tested with a 1500-volt spark test conforming to said specification.
 - g. Coating: Coal tar epoxy.
6. Quality Assurance: Hydrostatically tested to Manufacturer's published pressure rating prior to shipment.
7. Appropriately sized polyethylene sleeves, meeting AWWA C105 requirements, shall be included for direct bury applications.

B. Manufacturers

1. EBAA Iron, Inc. – Flex-Tend or equal. Force Balanced Flex-Tend where specified or shown on plans.

2.8 UNDERGROUND PIPE MARKERS

- A. As specified in Section 31 23 17, Trenching.

2.9 CONCRETE ENCASEMENT AND CRADLES

- A. Concrete:

1. As specified in Section 03 30 00 - Cast-in-Place Concrete.
2. Type: reinforced, air entrained as shown in the Drawings.
3. Compressive Strength: Minimum 3,000 psi at 28 days.
4. Finish: Rough troweled.

- B. Concrete Reinforcement: As specified in Section 03 20 00 - Concrete Reinforcing.

2.10 BEDDING AND COVER MATERIALS

- A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A2, as specified in Section 31 05 16, Aggregates for Earthwork.
2. Pipe Zone Backfill: Coarse Aggregate Material Type A2, as specified in Section 31 05 16, Aggregates for Earthwork.
3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A6, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2.11 GEOMEMBRANE FOR GAS LINE CROSSINGS

- A. Furnish 40 mil reinforced geomembrane with 300V/mil dielectric strength and minimum 150# puncture resistance and 150# tensile strength. Geomembrane shall be XR-5 as manufactured by Seaman Corporation or equal.

2.12 ACCESSORIES

- A. Concrete for Thrust Restraints: As specified in Section 03 30 00 - Cast-in-Place Concrete.
- B. Manhole and Cover: As specified in Section 33 05 13- Manholes.
- C. Miscellaneous Steel Rods, Bolt, Lugs, and Brackets:
 - 1. Comply with ASTM A36 or ASTM A307.
 - 2. Grade A carbon steel.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing utility water main size, location, and invert are as indicated on Drawings.

3.2 PREPARATION

- A. Preconstruction Site Photos:
 - 1. Take photographs along centerline of proposed pipe trench; minimum one photograph for each 50 feet of pipe trench.
 - 2. Show mailboxes, curbing, lawns, driveways, signs, culverts, and other existing Site features.
 - 3. Include Project name, date taken, and sequential number of each photograph in physical log or CD.
- B. Inspection:
 - 1. All pipe sections, specials, and jointing materials shall be carefully examined for defects.
 - 2. No piping or related materials shall be laid that is known to be defective. Any defective piece installed shall be removed and replaced with a new pipe section in a manner satisfactory to the Engineer at the Contractor's expense.
 - 3. Defective material shall be marked and removed from the job site before the end of the day.
- C. Pipe Cutting:

1. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, and remove burrs.
 2. Use only equipment specifically designed for pipe cutting; use of chisels or hand saws is not permitted.
 3. Grind edges smooth with beveled end for push-on connections.
 4. Prior to assembly of field cut pipe, the reference mark shall be re-established with a pencil or crayon. The location of the reference mark at the proper distance from the bevel end shall be in accordance with the Manufacturer's recommendations.
- D. Remove scale and dirt on inside and outside before assembly. Cleaning of each pipe or fitting shall be accomplished by swabbing out, brushing out, blowing out with compressed air, or washing to remove all foreign matter.
- E. Prepare pipe connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Bedding:

1. Excavation:
 - a. Excavate pipe trench as specified in Section 31 23 17, Trenching for Work of this Section.
 - b. All pipe trenches shall be excavated below the proposed pipe invert as required to accommodate the depths of pipe bedding material as scheduled on the Drawings.
 - c. Remove large stones or other hard matter which could damage pipe or impede consistent pipe bedding backfilling or compaction.
 - d. Trench base shall be inspected prior to placement of pipe.
 - e. Hand trim excavation for accurate placement of pipe to elevations as indicated on Drawings.
2. Dewater excavation as specified in Section 31 23 19, Dewatering to maintain dry conditions and to preserve final grades at bottom of excavation.
3. Provide sheeting and shoring as specified in Section 31 23 17, Trenching.
4. Place bedding material at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth and compact to 95 percent of maximum density.

B. Piping:

1. Install pipe according to AWWA C600.
2. Handle and assemble pipe according to Manufacturer instructions and as indicated on Drawings.
3. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
4. Steel Rods, Bolt, Lugs, and Brackets: Coat buried steel with one coat of coal tar coating before backfilling.
5. Sanitary Sewer Separation:
 - a. Install new water lines and appurtenances in compliance with local and state regulations governing the horizontal and vertical separations between water and sewer facilities.
 - b. Variance:
 - 1) If a variance is proposed due to requested design revisions or if an existing facility has been installed at a different location or elevation than indicated on the Plans, submit written proposal for review and approval by the Engineer.
 - 2) Include the reason for the variance, type of material and condition of the sewer line, location of the water and sewer facilities, horizontal and vertical skin-to-skin clearances and corrective measures proposed.
 - 3) Each variance will be considered on a case-by-case basis.
 - 4) Review Time: Allow a minimum of 5 working days review and response to each proposal.
6. Install ductile iron fittings according to AWWA C600.
7. Joints:
 - a. Pipe jointing surfaces shall be clean and dry when preparing surfaces for joining.
 - b. Lubricants, primers, adhesives, etc. shall be used as recommended by the Pipe or Joint Manufacturer's specifications.
 - c. The jointing materials or factory-fabricated joints shall then be placed, fitted, joined, and adjusted in such a manner as to obtain a watertight joint.

- d. Trenches shall be kept water-free and as dry as possible during bedding, laying, and jointing.
 - e. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to prevent movement of the pipe from any cause.
8. Flanged Joints: Not to be used in underground installations except within structures, unless shown otherwise in the Drawings.
9. Install pipe and fittings to the line and grade specified on the Drawings, with joints centered, pipe properly supported and restrained against movement, and all valve stems plumb. Re-lay pipe that is out of alignment or grade.
10. High Points:
- a. Install pipe with no high points, unless otherwise shown in the Drawings.
 - b. If unforeseen field conditions arise that necessitate high points, install air release valves as directed by Engineer.
11. Bearing:
- a. Install pipe to have bearing along entire length of pipe.
 - b. Excavate bell holes to permit proper joint installation where necessary or as directed by Engineer.
 - c. Do not lay pipe in wet or frozen trench.
12. Prevent foreign material from entering pipe during placement.
13. Install pipe to allow for expansion and contraction without stressing pipe or joints.
14. Close pipe openings with watertight plugs during Work stoppages.
15. All pipe ends which are to be permanently closed shall be plugged or capped and restrained against internal pressure.
16. Install access fittings to permit disinfection of water system performed under Section 33 13 00 – Testing and Disinfecting of Water Utility Piping.
17. Cover:
- a. Establish elevations of buried piping with not less than 36 inches of cover.
 - b. Measure depth of cover from final surface grade to top of pipe barrel.

- C. Tapping Sleeves and Valves:
 - 1. As indicated on Drawings and according to Manufacturer instructions.
- D. Thrust Restraints:
 - 1. Provide valves, tees, bends, caps, and plugs with concrete thrust blocks at locations shown in the Drawings and as required to facilitate testing of lines.
 - 2. Pour concrete thrust blocks against undisturbed earth.
 - 3. Locate thrust blocks to ensure that pipe and fitting joints will be accessible for repair.
 - 4. Provide thrust restraint bearing area on subsoil as shown in details within the Drawings.
 - 5. Install tie rods, clamps, setscrew retainer glands, or restrained joints.
 - 6. Protect metal-restrained joint components against corrosion with polyethylene film or wax tape as specified herein.
 - 7. Avoid encasing mechanical and flanged joints in concrete. Provide clearance between concrete and mechanical and flange joints to allow future bolt removal.
- E. Backfilling:
 - 1. Backfill of piping systems shall be as specified in Section 31 23 17, Trenching.
- F. Testing and Disinfection of Potable Water Piping System:
 - 1. In accordance with AWWA C600 and AWWA C651 and as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Piping.
 - 2. All chlorinated water used in disinfection of the water main shall either be discharged through an approved connection to a public sanitary sewer system or shall be dechlorinated to limits acceptable by the Washington State Department of Ecology (Ecology) prior to discharge into any storm drainage system or open drainage way.
 - 3. No chlorinated water shall be discharged into a storm drainage system or open drainage way without a dechlorination under a plan meeting Ecology's requirements.

3.4 FIELD QUALITY CONTROL

- A. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

END OF SECTION

SECTION 33 12 16
WATER UTILITY DISTRIBUTION AND TRANSMISSION VALVES

PART 1 \GENERAL

1.1 SUMMARY

- A. This Section includes valves and valve boxes for installation with buried water distribution and transmission main, including fire hydrants and tapping sleeves.
- B. Section Includes:
 - 1. Valves.
 - 2. Valve boxes.
 - 3. Valve operator extensions.
- C. Related Sections:
 - 1. Section 03 30 00 - Cast-in-Place Concrete: Concrete for thrust restraints
 - 2. Section 33 11 10 - Water Utility Distribution and Transmission Piping: Piping trenching, backfilling, and compaction requirements.
 - 3. Section 33 13 00 - Testing and Disinfecting of Water Utility Piping: Flushing and disinfection requirements.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
 - 3. ASME 1.20.1 - General Purpose Pipe Threads (Inch)
- B. American Water Works Association (AWWA):
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.
 - 2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service
 - 3. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants

4. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 5. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
- C. ASTM International (ASTM):
1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings
 2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications
- D. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects
 2. NSF 372 - Drinking Water System Components - Lead Content

1.3 COORDINATION

- A. The Contractor shall cause the Supplier of valves to coordinate installation such that all pipes, valves, fittings, appurtenances, and equipment are compatible and capable of achieving the performance requirements specified in the Contract Documents.
- B. Coordinate Work of this Section with City of Port Orchard Public Works Engineering standards and utilities within construction area.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Lining and coating data.
- F. Valve Labeling: Schedule of valves to be labeled indicating in each case the valve location and the proposed labeling for the valve.

- G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit information for valves.

1.6 QUALITY ASSURANCE

- A. Cast Manufacturer's name, maximum working pressure, size of valve, and year of fabrication into valve body.
- B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.
- C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, American National Standards Institute (ANSI), ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.
- D. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
- E. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves and accessories for shipment according to applicable AWWA standards.
- B. Seal valve and ends to prevent entry of foreign matter.
- C. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- D. Storage:
 - 1. Store materials in areas protected from weather, moisture, or other potential damage.

2. Do not store materials directly on ground.
- E. Handle products carefully to prevent damage to interior or exterior surfaces.
- F. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT WEDGE GATE VALVES

- A. As specified in Section 40 05 51.15, Gate Valves.
- B. Connecting Hardware:
 1. As specified in Article 2.3, Nuts, Bolts and Washers of Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Gaskets:
 1. As required for the end connection types specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 ACTUATORS

- A. Unless otherwise indicated, all valves shall be furnished with manual actuators.
- B. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.
- C. All gear-assisted valves that are buried and submerged shall have the actuators hermetically sealed and grease-packed.
- D. All valves 6 inches to 30 inches in diameter may have traveling-nut actuators, as appropriate for each valve.

2.4 VALVE BOXES

- A. Provide all buried valves with valve boxes, covers and risers.
- B. All valve boxes shall be constructed per City of Port Orchard Standard Drawing 884 and as specified in City of Port Orchard Public Works Engineering Standards and Specifications.
- C. Valve Boxes:
 - 1. Materials: Cast iron.
 - 2. Construction:
 - a. Walls not less than 3/16-inch thick at any point.
 - b. Internal diameter not less than 5 inches.
 - 3. Type: Two-piece extension.
 - 4. Manufacturers:
 - a. Olympic Foundry.
- D. Covers:
 - 1. Construction:
 - a. Prevents dislodging and rotation from traffic.
 - b. Allows a hand-held pry bar to be applied for easy removal.
 - 2. Materials: Cast iron.
 - 3. Lid Inscription: WATER.
 - 4. Manufacturers: Matching that of valve box.

2.5 VALVE OPERATOR EXTENSIONS

- A. As shown in the Drawings.
- B. Provide operator extensions to a maximum of 18 inches below grade where depth to valve exceeds 36 inches to a maximum of 65 inches.

2.6 ACCESSORIES

- A. Concrete for Thrust Restraints: Concrete type as specified in Section 03 30 00 - Cast-in-Place Concrete.

PART 3 EXECUTION

3.1 PREPARATION

- A. Conduct operations to not interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures, utilities, and landscape in immediate or adjacent areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. Locate, identify, and protect from damage utilities to remain.
- D. Access:
 - 1. All valves shall be installed to provide easy access for operation, removal, and maintenance.
 - 2. Avoid conflicts between valve operators and above grade construction such as structural members or handrails.
- E. Valve Accessories:
 - 1. Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly.
 - 2. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.2 INSTALLATION

- A. General:
 - 1. All valves, operating units, stem extensions, valve boxes, and accessories shall be installed in accordance with the Manufacturer's written instructions and as shown in the Drawings and as specified herein.
 - 2. Valves shall be firmly supported to avoid undue stresses on the pipe.
 - 3. Stem extensions shall be braced at no greater than 10 feet intervals and be provided with double universal joints to allow for misalignment, where applicable.

- B. Perform trench excavation, backfilling, and compaction as specified in Section 33 11 10, Water Utility Distribution and Transmission Piping.
- C. Install valves in conjunction with pipe laying.
- D. Set valves plumb.
- E. Provide buried valves with valve boxes installed flush with finished grade.
 - 1. Valves installed out of paved or otherwise hard-surfaced areas shall be set in a concrete pad at finished grade.
 - 2. Concrete valve box pads shall be 18 inches square and be not less than 6 inches thick.
- F. Disinfection of Water Piping System:
 - 1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

3.3 FIELD QUALITY CONTROL

- A. Pressure test valving for water distribution system according to AWWA C600 and in accordance with Section 33 13 00, Testing and Disinfection of Water Utility Piping.

END OF SECTION

SECTION 33 13 00
TESTING AND DISINFECTION OF WATER UTILITY PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes hydrostatic pressure testing, disinfection, and purity testing of potable water systems piping, fittings, valves, and domestic water services.
- B. Section Includes:
 - 1. Pressure testing and disinfection of potable water distribution and transmission piping systems and appurtenances.
 - 2. Testing and reporting of results.
- C. Related Sections:
 - 1. Section 33 11 10 - Water Utility Distribution and Transmission Piping
 - 2. Section 33 12 16 - Water Utility Distribution and Transmission Valves

1.2 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA B300 - Hypochlorites
 - 2. AWWA B301 - Liquid Chlorine
 - 3. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances
 - 4. AWWA C605 - Underground Installation of PVC and PVCO Pressure Pipe and Fittings
 - 5. AWWA C651 - Disinfecting Water Mains
 - 6. AWWA C655 - Field Dechlorination

1.3 SUBMITTALS

- A. Section 01 33 00 –Submittals Procedures: Requirements for submittals.
- B. Product Data: Submit procedures, proposed chemicals, and treatment levels.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- D. Pipeline Testing and Disinfection Plan: To be submitted for review and approval by the Engineer a minimum of 1 month before testing is to start. As a minimum, the plan shall include the following:
1. Testing schedule.
 2. Hydrostatic Testing Plan:
 - a. Narrative of the proposed process.
 - b. Proposed equipment to be used.
 - c. Disposal location for excess water used to fill mains.
 3. Disinfection Plan:
 - a. Narrative of the proposed process.
 - b. Proposed chemicals and equipment (including list of all pumps and meters) to be used.
 - c. Calculations for the amount of chlorine required to achieve required chlorine residual levels.
 - d. Proposed method of mixing, injecting, and distributing of chlorine solution throughout all portions of the new water system facilities.
 - e. Proposed plan for testing chlorine levels throughout the length of pipeline.
 4. Proposed testing locations.
 5. Proposed plan for water conveyance, including flow rates.
 6. Proposed plan for water control.
 7. Proposed plan for water disposal, including flow rates. Include proposed plan for dechlorination of disinfection water, including discharge points.
 8. Proposed measures to be incorporated in the Project to minimize erosion while discharging water from the pipeline.

1.4 CLOSEOUT SUBMITTALS

- A. 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.

1.5 QUALITY ASSURANCE

- A. Perform Work according to AWWA C651.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future functions.
- B. All temporary thrust restraint and equipment and facilities required for hydrostatic testing will be considered incidental.
- C. As a minimum, furnish the following equipment and materials for the testing:

Amount	Description
2	Graduated containers approved by the Engineer.
1	Hydraulic pump approved by the Engineer with hoses, valves, and fittings as needed and required for the testing and disinfection of the facilities.
1	High range chlorine test kit, as approved by Engineer, with digital readout. Range of detection shall be between 5 and 200 ppm. Accuracy of 3 percent.
2	Pressure gauges with pressure range at least 120 percent greater than the required maximum test pressure with graduations in 2 pounds per square inch (psi) increments. Gauges shall have been calibrated with 90 days of pressure testing.

2.2 DISINFECTION CHEMICALS

A. Chemicals:

1. Hypochlorite: Comply with AWWA B300.
2. Liquid chlorine: Comply with AWWA B301.

2.3 DECHLORINATION CHEMICALS

A. Chemicals:

1. Comply with AWWA C655.

PART 3 EXECUTION

3.1 HYDROSTATIC TESTING OF WATER PIPING

- A. Conduct hydrostatic testing in accordance with City of Port Orchard Public Works Engineering Standards and Specifications.
- B. Make all necessary provisions for conveying water to the points of use and for the disposal of test water.
- C. No section of the pipeline shall be hydrostatically tested until backfill has been placed, compacted, and passed required density testing and all field-placed concrete or mortar has attained full strength.
 1. At the Contractor's option, early strength concrete may be used when the full-strength requirements conflict with schedule requirements.
 2. All such substitutions and installations shall be approved by the Engineer prior to installation.
- D. Provide 72-hour notification to the Engineer and Owner prior to conducting hydrostatic testing.
 1. Provide coordination and scheduling required for the Owner and Engineer to witness and provide necessary labor for operating Owner's existing system during hydrostatic testing and disinfecting procedures.
 2. The Contractor shall not operate any part of the existing water systems.
- E. Pipe Filling:

1. Fill pipes slowly from the lowest elevation to highest point along test section with potable water.
 2. Take all required precautions to prevent entrapping air in the pipes.
 3. Allow for natural absorption of water by the lining of the pipe to occur.
 4. Apply specified test pressure by pumping.
- F. Testing of Mains:
1. Ductile Iron: In accordance with AWWA C600.
 2. General:
 - a. Tests shall be conducted under a hydrostatic test pressure not less than 1.25 times the stated anticipated maximum sustained working pressure of the pipeline measured at the highest elevation along the test section and not less than 1.5 times the stated working pressure at the lowest elevation of the test section, minimum 250 psi, unless otherwise shown in the Drawings.
 - b. In no case shall the test pressure exceed the rated working pressure for any joint, thrust restraint, valve, fitting, or other connected appurtenance of the test section.
 - c. Testing shall be performed by applying the specified test pressure by pumping.
 - d. Once the test pressure has been attained, the pump shall be valved off.
 - e. The test will be conducted for a 1-hour period with the allowable leakage not to exceed the value as calculated per the Allowable Leakage formula below.
 - f. During the test period, there shall be no appreciable or abrupt loss in pressure.
 3. Allowable Leakage:
 - a. Flanged Joints: Pipe, fittings, and valves with flanged joints shall be completely watertight. No leakage allowed.
 - b. Mechanical or Push-on Joints: Pipe, fittings, and valves with rubber gasketed joints shall have a measured loss not to exceed the rate given in the following Allowable Leakage formula:

$$AL = \frac{LD(P)^{1/2}}{148,000}$$

In the above formula:

- AL = Allowable leakage, in gallons per hour
- L = Length of pipe tested, in feet
- D = Nominal diameter of pipe, in inches
- P = Average test pressure during the leakage test, in pounds per square inch.

4. Maintaining Pressure:

- a. During the test period, operate the pump as required to maintain pressure in the pipe within 5 psi of the specified test pressure at all times.
- b. At the end of test period, operate the pump until the specified test pressure is again obtained.
 - 1) The pump suction shall be in a clean, graduated barrel, or similar device or metered so that the amount of water required to restore the test pressure may be accurately measured.
 - 2) Sterilize this makeup water by adding chlorine to a concentration of 50 milligrams per liter (mg/L).
- c. The Engineer will determine the quantity of water required to maintain and restore the required pressure at the end of the test period.
- d. Each hour's loss stands on its own and will not be averaged.

5. Defects, Leakage, Failure:

- a. If the test reveals any defects, leakage in excess of the allowable, or failure, furnish all labor, equipment, and materials required to locate and make necessary repairs.
- b. Correct any visible leakage regardless of the allowable leakage specified above.
- c. All leaks shall be repaired in a manner acceptable to the Engineer.
- d. The testing of the line shall be repeated until a test satisfactory to the Engineer has been achieved.

3.2 DISINFECTION OF WATER PIPING

- A. Disinfection shall be in accordance with the latest version of AWWA C651 following Engineer's acceptance of hydrostatic testing.
- B. Chlorination by means of tablets or powders (calcium hypochlorite) placed in each length of pipe during installation is specifically prohibited.

- C. Flush all foreign matter from the pipeline, branches, and services.
 - 1. Provide at no additional cost to the Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.
 - 2. Flushing velocities shall be at least 2.5 feet per second (fps).
 - 3. For large diameter pipe where it is impractical or impossible to flush the pipe at 2.5 fps velocity, clean the pipe in place from the inside by brushing and sweeping, then flush the line at a lower velocity.
- D. Chlorine Application:
 - 1. Fill the test section of main from the lowest elevation and maintain a steady flow rate while injecting the water main with chlorinated water.
 - 2. Flow (bleed) a blow-off, standpipe or hydrant at the water main's high point(s) to allow air to escape and ensure all interior pipe surfaces are wetted.
- E. Chlorine Residual:
 - 1. Measure chlorine residual with a high-range chlorine test kit at a point near to the injection point while filling the main.
 - 2. Adjust the dose rate as necessary to maintain the target dose rate.
- F. Potable water piping shall be disinfected with a solution containing a minimum 25 ppm and a maximum 50 ppm chlorine.
 - 1. Once the main is completely filled with super-chlorinated water, measure the chlorine residual a minimum of once every 200 feet of main and once for each main branch, 2-inch service, or as directed by the Engineer.
 - 2. The chlorine solution shall remain in the piping system for a period of 24 hours, after which time the sterilizing mixture shall have a strength of at least 10 ppm of chlorine.
 - 3. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained.
- G. Flush piping, branches, and services with municipal potable water until the chlorine residual is below 1.5 ppm and approximately the same as the source water.
 - 1. There is no minimum flushing velocity for this step.
- H. Disposal of any water containing chlorine shall be performed in accordance with the latest edition of AWWA C651 and C655, and all state or local requirements.

1. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective system owners.
2. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge to levels acceptable by Washington State Department of Ecology(Ecology).

3.3 DISINFECTION AND TESTING OF WATER MAIN END CONNECTIONS AND TIE-INS

- A. Disinfection of potable water piping and appurtenances at end connections and tie-ins to the existing system which are required to remain in service due to restrictions in allowable shutdown time shall be disinfected as described below.
- B. Prior to connecting new potable water piping and appurtenances with existing piping and appurtenances, the interior of all new pipe, fittings, valves, and appurtenances shall be swabbed or sprayed with a 1 percent to 5 percent calcium hypochlorite solution.
- C. In accordance with AWWA C651, swabbing or spraying of connection piping is allowed only if the total length of piping is equal to or less than one pipe length (18 feet). All runs of new piping over 18 feet in total length will require hydrostatic pressure testing, flushing and disinfection as detailed elsewhere in this Section.
- D. Following the disinfection procedures described above, connection of the new piping and appurtenances to the existing water system shall be made.
 1. During the system startup, the Engineer and Contractor shall visually inspect all new fittings, piping, valves, and appurtenances for evidence of leakage.
 2. Any leakage observed during this period shall be promptly repaired by the Contractor, at Contractor's expense, as required by the Engineer.

3.4 FIELD QUALITY CONTROL

- A. Bacteriological Sampling and Testing:
 1. The Owner will collect samples after the line is flushed in accordance with the latest edition of AWWA C651.
 - a. The locations for sample collection shall be at the sole discretion of the Owner and Engineer.
 - b. The chlorine residual must be below 1.5 ppm or restored to the level maintained in the Owner's distribution system, when the sample is taken.

2. Bacterial Testing: After completing the chlorination procedure, test the main according to the following:
 - a. Bacterial Sampling
 - 1) Option A:
 - a) Take an initial set of samples using sampling site procedures outlined herein.
 - b) Resample after a minimum of 24 hours' time has elapsed using sampling site procedures outlined herein.
 - c) Both sets of successive samples must pass for the main to be approved for service.
 - 2) Option B:
 - a) Allow main to sit for a minimum of 24 hours without any water use.
 - b) Using sampling site procedures outlined herein, collect two sets of samples a minimum of 15 minutes apart while the sampling taps are left running.
 - c) Both sets of samples must pass for the main to be approved for service.
 - 3) Allow 24 hours for the test results for each sample set.
 - b. Sampling Locations
 - 1) The Owner will take one bacteriological sample from the end of the main and on each branch.
 - 2) For long runs of main, at least one sample will be taken for every 1,200 feet of new main and as directed.
 - c. Sample Testing
 - 1) The Owner will test the sample set for coliform bacteria and publish the test results within 24 hours.
 - d. Evaluating the Test Results
 - 1) If one or more of the sample set tests positive for coliforms (fails), repeat chlorination and sampling processes specified herein after correcting the cause of the failure and as directed by the Engineer.

2) When two consecutive sample sets test negative (passing) for coliform bacteria, the bacterial testing is complete.

e. Completion of Bacterial Testing

1) Upon completion of bacterial testing, notify the Owner shall notify the Engineer and Contractor in writing that the testing is complete and the main is ready for tie-in.

f. Multiple Positive (Failing) Test Results

1) If sample sets continue to test positive for coliforms, the Engineer will determine how to proceed, up to and including repeating the chlorination procedure or rejecting the pipe.

3. Results of the bacteriological testing shall be satisfactory with the Washington Department of Health and/or other appropriate regulatory agencies, or disinfection shall be repeated by the Contractor.

B. Optional Sampling and Testing

1. If a pipeline is not promptly returned to service, the situation will be evaluated by the Owner to determine if the water quality may have been impacted and if additional testing as specified herein is warranted.

END OF SECTION

SECTION 33 13 13
DISINFECTION OF WATER UTILITY STORAGE TANKS

PART 1 GENERAL

1.1 SUUMMARY

- A. This Section includes methods of disinfecting water storage tanks for potable water.
- B. Section includes:
 - 1. Water storage tank disinfection.
 - 2. Bacteriological testing.

1.2 REFERENCE STANDARDS

- A. American Water Works Association (AWWA):
 - 1. AWWA C652 - Disinfection of Water Storage Facilities

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Disinfection Procedure:
 - 1. Submit description of procedure, including type of disinfectant and calculations indicating quantities of disinfectants required to produce specified chlorine concentration.
 - 2. Comply with Sections 3 and 4 of AWWA C652.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Certify that disinfectants meet or exceed AWWA C652 requirements.
- E. Test and Evaluation Reports: Indicate results of bacteriological and residual chlorine laboratory test reports.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 QUALITY ASSURANCE

- A. Perform Work in compliance with AWWA C652.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- B. Store disinfectants according to Manufacturer's recommendations and in a cool, dry place away from combustibles such as wood, rags, oils, and greases.
- C. Handle disinfectants according to Manufacturer's safety precautions.

PART 2 PRODUCTS

2.1 DISINFECTANTS

- A. Chlorine Forms: According to AWWA C652, Section 4.
 - 1. Liquid chlorine
 - 2. Sodium hypochlorite
 - 3. Calcium hypochlorite

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspection:
 - 1. Conduct inspection of tank interior before beginning disinfection.
 - 2. Verify tank is clean and free of polluting materials.
 - 3. Verify tank piping and vent connections are properly made and clear of obstructions.
 - 4. Verify all interior paint is thoroughly cured according to Paint Manufacturer's instructions.

3.2 PREPARATION

- A. Furnish personnel working inside tank during disinfection with equipment to comply with Federal and State regulations for Work conducted in a hazardous atmosphere.
- B. Coordinate with the Engineer and Owner for scheduling of disinfection activities.

1. The Owner may require up to 1 weeks' time following notice to supply water for filling of reservoir.

3.3 APPLICATION

- A. Use Chlorination Method 2 for disinfecting tank in Section 4 of AWWA C652, generally detailed as followed:
 1. Spray or brush a solution of 200 milligrams per liter (mg/L) available chlorine directly on the surfaces of all parts of the storage facility that will be in contact with water when the storage facility is full to the overflow elevation.
 2. The solution shall thoroughly coat all surfaces to be treated, including the inlet and outlet piping and shall be applied to any separate drain piping such that it will have available chlorine of not less than 10 mg/L when filled with water.
 3. Disinfected surfaces shall remain in contact with the strong chlorine solution for at least 30 minutes.
 4. Following the completion of the chlorination procedure, potable water shall be admitted, the drain piping purged of the 10 mg/L chlorinated water, and the storage facility filled to its overflow level.
- B. A sample shall be taken by the Owner for microbiological analysis according to State Health Standards for potable water.
 1. Contact the Engineer and/or Owner to arrange for samples to be taken for microbiological analysis.
 2. Microbiological analysis must indicate that the water is free of coliform organisms before the facility can be put into service.
 3. It will not be necessary to flush the reservoir or tank after the chlorine solution is applied by spraying or brushing providing a passing microbiological test is achieved.
- C. When water samples fail to meet State Health Standards for potable water, perform corrective measures until water quality conforms to State Health Standards.
- D. Any super-chlorinated water shall be discharged through an approved connection to the public sanitary sewer system or shall be dechlorinated to limits acceptable by the Washington State Department of Ecology (Ecology) for discharge into the existing storm drainage system. If super-chlorinated water is to be discharged into the public sanitary sewer system, notify the sewage treatment plant notifying the planned time, location, and quantity of discharge. No super-chlorinated water shall be discharged into the storm drainage system or natural drainage way prior to approved dechlorination treatment.

END OF SECTION

**SECTION 33 13 19
DISINFECTION OF WATER SUPPLY WELLS**

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section covers the disinfection of an existing well or wells associated with a well development and pump project. Prior to their use, disinfection, and purity testing of each existing well and associated pumps, piping, fittings, and valves will be accomplished. All costs for labor and materials necessary to conduct the disinfecting and testing procedures specified herein shall be borne by the Contractor. The work under this section will be coordinated with that required under Section 33 13 00, Testing and Disinfection of Water Utility Piping.

- B. The Contractor shall provide 72-hour notification to the Engineer and Owner prior to conducting disinfection of each well and associated appurtenances. Contractor shall provide coordination and scheduling required for the Owner and Engineer to witness and provide necessary labor for operating Owner’s existing system, if necessary, during the disinfecting procedures. Contractor shall not operate any part of the existing water system.

- C. The Contractor shall perform flushing and testing of each well and associated pumps, piping, fittings, and valves pipelines for potable water, complete, including conveyance of test water to point of use and all disposal thereof, all in accordance with the requirements of the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

Codes and Standards - Comply with the provisions of the following codes, standards, and specifications, except as otherwise shown and specified.

ANSI/AWWA B300 Hypochlorites

ANSI/AWWA B301 Liquid Chlorine

ANSI/AWWA C651-99 Disinfecting Water Mains

ANSI/AWWA C600-99 Installation of Ductile-Iron Water Mains and Their Appurtenances

1.3 CONTRACTOR SUBMITTALS

A testing schedule, including proposed plans for water conveyance, control, disposal, disinfection, and dechlorination shall be submitted in writing for approval a minimum of 1 week before testing is to start.

PART 2 PRODUCTS

2.1 EQUIPMENT

- A. All test equipment, chemicals for chlorination, temporary valves, bulkheads, or other water control equipment and materials shall be determined and furnished by the Contractor subject to the Engineer's review. No materials shall be used which would be injurious to the construction or its future functions.
- B. Chlorine for disinfection shall be in the form of liquid chlorine, sodium hypochlorite solution, or calcium hypochlorite granules or tablets.
- C. Sodium hypochlorite and calcium hypochlorite shall be in accordance with the requirements of ANSI/AWWA B300.

PART 3 EXECUTION

3.1 DISINFECTION OF WATER WELLS AND APPURTENANCES

- A. At all times during the progress of the work, the Contractor shall protect each existing well in such a manner as to effectively prevent either tampering with the well or entrance of foreign matter.
- B. Each existing well will be provided to the Contractor capped and in a completed and tested condition and free of foreign substances. If the Contractor contaminates the existing well or wells with foreign substances, the Contractor shall clean the well or wells of those foreign substances.
- C. Before sterilizing, flush all foreign matter from each well and associated piping, valves, and appurtenances. The Contractor is to provide at no additional cost to Owner, hoses, temporary pipes, ditches, etc., as required to dispose of flushing water without damage to adjacent properties.
- D. Each well shall be disinfected in conformance with the state, local, and federal codes and regulations and as follows. Place chlorine solution at a strength and volume to produce an available chlorine concentration of at least 50 milligrams per liter to the entire water depth in each well. Mix to ensure distribution throughout water depth of the well. The chlorine solution shall remain in the well for a period of 24 hours at which time the sterilizing mixture shall have a residual concentration of at least 25 parts per million of chlorine. If check samples fail to produce acceptable results, the disinfection procedure shall be repeated at the expense of the Contractor until satisfactory results are obtained. The interior of all new pipe, fittings, valves, and appurtenances shall be swabbed or sprayed with a 1 percent calcium hypochlorite solution.

- E. After disinfection, each well and associated appurtenances shall be thoroughly flushed by the Contractor in accordance with AWWA C651-99. The Contractor shall make all necessary provisions for conveying water to the points of use and for the disposal of test water. Disposal of any water containing chlorine shall be performed in accordance with AWWA C651 and any other state and local requirements. Disposal may be made into existing sanitary sewer systems providing approvals are obtained from the respective sewerage agency. Any chlorinated water discharged to open stream channels must be dechlorinated prior to discharge.

- F. The Owner will collect samples after each well is flushed at a location directed by Engineer. The chlorine residual must be below 1.5 milligrams per liter when the sample is taken. Results of the bacteriological testing shall be satisfactory with the State Department of Health and/or other appropriate regulatory agencies, or disinfection shall be repeated at the expense of the Contractor.

END OF SECTION

**SECTION 33 30 10.13
SEWER AND MANHOLE TESTING**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes methods for testing of gravity sewer piping, pressure sewer piping, and manholes.
- B. Section includes:
 - 1. Testing of Gravity Sewer Piping:
 - a. Low pressure air testing.
 - 2. Testing of pressure piping.
 - 3. Deflection testing of plastic sewer piping.
 - 4. Testing of Manholes:
 - a. Vacuum testing.
 - b. Exfiltration testing.
- C. Related Sections:
 - 1. Section 33 05 13 - Manholes.
 - 2. Section 33 13 00 - Testing and Disinfection of Water Utility Piping.
 - 3. Section 33 41 10 - Storm Utility Drainage Piping.

1.2 REFERENCE STANDARDS

- A. ASTM International:
 - 1. ASTM C1244 - Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill.
 - 2. ASTM D2122 - Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings.
- B. American Water Works Association:
 - 1. AWWA C600 - Installation of Ductile Iron Mains and Their Appurtenances.

2. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Submit following items prior to start of testing:
 1. Testing procedures.
 2. List of test equipment.
 3. Testing sequence schedule.
 4. Provisions for disposal of flushing and test water.
 5. Certification of test gauge calibration.
 6. Deflection mandrel drawings and calculations.
- C. Test and Evaluation Reports: Indicate results of manhole and piping tests.

PART 2 PRODUCTS

2.1 VACUUM TESTING

- A. Equipment:
 1. Vacuum pump.
 2. Vacuum line.
 3. Vacuum Tester Base:
 - a. Compression band seal.
 - b. Outlet port.
 4. Shutoff valve.
 5. Stopwatch.
 6. Plugs.
 7. Vacuum Gauge: Calibrated to 0.1 in. Hg (0.34 kPa).

2.2 EXFILTRATION TESTING

- A. Equipment:
 - 1. Plugs.
 - 2. Pump.
 - 3. Measuring device.

2.3 AIR TESTING

- A. Equipment:
 - 1. Air compressor.
 - 2. Air supply line.
 - 3. Shutoff valves.
 - 4. Pressure regulator.
 - 5. Pressure relief valve.
 - 6. Stopwatch.
 - 7. Plugs.
 - 8. Pressure Gauge: Calibrated to 0.1 psi.

2.4 HYDROSTATIC TESTING

- A. Equipment:
 - 1. Hydro pump.
 - 2. Pressure hose.
 - 3. Water meter.
 - 4. Test connections.
 - 5. Pressure relief valve.
 - 6. Pressure Gauge: Calibrated to 0.1 psi.

2.5 DEFLECTION TESTING

- A. Equipment:
 - 1. "Go, no go" mandrels.
 - 2. Pull/retrieval ropes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify manholes and piping are ready for testing.
- B. Verify trenches are backfilled.
- C. Verify pressure piping thrust restraint system is installed, as may be required.

3.2 PREPARATION

- A. All gravity sewer pipe shall be cleaned and flushed after backfilling and compaction in accordance with Section 7-17.3(2)A of the WSDOT Standard Specifications.
- B. Obstructions:
 - 1. After backfilling and restoration of surfaces, gravity pipelines shall be inspected for obstructions and shall be cleaned.
 - 2. Pipes less than 24 inches in diameter shall be cleaned using the sewer ball method.
 - 3. Lines larger than 36 inches in diameter may be cleaned by flushing as long as they are first visually inspected to assure that no physical obstructions exist.
 - a. Flushing shall be such that velocities are at least 2.5 feet per second.
- C. Lamping:
 - 1. Lamp gravity piping after flushing and cleaning of lines, checking manholes for unfinished work.
 - 2. Perform lamping operation by shining light at one end of each pipe section between manholes.
 - 3. Observe light at other end.
 - 4. Pipe not installed with uniform line and grade will be rejected.

5. Remove and reinstall rejected pipe sections.
6. Reclean and lamp until pipe section is installed to uniform line and grade.

D. Plugs:

1. Plug outlets, wye branches, and laterals.
2. Brace plugs to resist test pressures.

3.3 FIELD QUALITY CONTROL

A. Testing of Gravity Sewer Piping:

1. All gravity sewer pipe shall be tested in accordance with Section 7-17.3(2)F of the WSDOT Standard Specifications.
2. Low Pressure Air Testing:
 - a. Test each reach of gravity sewer piping between manholes.
 - b. Introduce air pressure slowly to approximately 4 psig.
 - 1) Determine ground water elevation above spring line of piping.
 - 2) For every foot of ground water above spring line of piping, increase starting air test pressure by approximately 0.4 psi.
 - 3) Do not increase pressure above 10 psig.
 - c. Allow pressure to stabilize for at least five minutes.
 - d. Adjust pressure to 3.5 psig or to increased test pressure as determined above when ground water is present.
 - e. Testing:
 - 1) Determine test duration for reach of sewer with single pipe size from following table; do not make allowance for laterals.

**Table 33 30 10.13 - 1
Air Testing Duration for Gravity Sewer Piping**

NOMINAL PIPE SIZE, INCHES	MINIMUM TESTING TIME, MIN/100 FEET
6	0.7
8	1.2

NOMINAL PIPE SIZE, INCHES	MINIMUM TESTING TIME, MIN/100 FEET
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0

- 2) Record drop in pressure during testing period.
- 3) If air pressure drops more than 1.0 psi during testing period, piping has failed.
- 4) If 1.0 psi air pressure drop has not occurred during testing period, piping is acceptable; discontinue testing.
- 5) If piping fails, test reach of piping in incremental stages until leaks are isolated, repair leaks, and retest entire reach between manholes.

B. Testing of Pressure Piping:

1. Test system according to AWWA C600 and the requirements of Section 33 13 00, Testing and Disinfection of Water Utility Piping.

C. Deflection Testing of Plastic Sewer Piping:

1. Perform vertical ring deflection testing on PVC and acrylonitrile butadiene styrene (ABS) sewer piping after backfilling has been in place for at least 30 days but not longer than 12 months.
2. Allowable maximum deflection for installed plastic sewer pipe is no greater than five percent of original vertical internal diameter.
3. Perform deflection testing using properly sized rigid ball or "go, no go" mandrel.
4. Furnish rigid ball or mandrel with diameter not less than 95 percent of base or average inside diameter of pipe, as determined by ASTM standard to which pipe is manufactured; measure pipe diameter in compliance with ASTM D2122.

5. Perform testing without mechanical pulling devices.
6. Locate, excavate, replace, and retest piping that exceeds allowable deflection.

D. Testing of Manholes:

1. Description:

- a. Option of air testing or exfiltration testing.
- b. If air testing, test whenever possible prior to backfilling in order to more easily locate leaks.
- c. Repair both outside and inside of joint to ensure permanent seal.
- d. Test manholes with manhole frame set in place.

2. Vacuum test according to ASTM C1244 and following:

- a. Plug pipe openings; securely brace plugs and pipe.
- b. Inflate compression band to create seal between vacuum base and structure.
- c. Connect vacuum pump to outlet port with valve open, then draw vacuum to 10 in. Hg .
- d. Close valve.
- e. Testing:

1) Determine manhole testing duration using following table:

MANHOLE DIAMETER (feet)	TEST PERIOD
4	60 seconds
5	75 seconds
6	90 seconds

- 2) Record vacuum drop during test period.
- 3) If vacuum drop is greater than 1 in. Hg during testing period, repair and retest manhole.
- 4) If vacuum drop of 1 in. Hg does not occur during test period, manhole is acceptable; discontinue testing.

- 5) If vacuum test fails to meet 1 in. Hg drop in specified time after repair, repair and retest manhole.
3. Exfiltration Testing:
 - a. Plug pipes in manhole.
 - b. Remove water from manhole.
 - c. Observe plugs over period of not less than two hours to ensure that there is no leakage into manhole.
 - d. Determine ground water level outside manhole.
 - e. Fill manhole with water to its rim at the start of the test.
 - f. Prior to testing, allow manhole to soak from minimum of four hours to maximum of 72 hours.
 - g. After soak period, adjust water level to rim of manhole.
 - h. Leakage in the manhole shall not exceed 0.2 gallons per foot of head above the highest invert after a one-hour test period.
 4. If unsatisfactory testing results are achieved, repair manhole and retest until result meets criteria.
 5. Repair visible leaks regardless of quantity of leakage.

END OF SECTION

SECTION 33 31 10
SANITARY UTILITY SEWERAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes pipe materials, manholes, and accessories normally used with gravity sanitary sewers.
- B. Section includes:
 - 1. Sanitary sewerage pipe and fittings.
 - 2. Pipe markers.
 - 3. Connection to existing manholes.
 - 4. Manholes.
 - 5. Wye branches and tees.
 - 6. Sanitary laterals.
 - 7. Bedding and cover materials.
- C. Related Sections:
 - 1. Section 03 20 00 - Concrete Reinforcement
 - 2. Section 03 11 00 - Concrete Work
 - 3. Section 03 62 00 – Non-Shrink Grout
 - 4. Section 31 05 13 - Soils for Earthwork
 - 5. Section 31 05 16 - Aggregates for Earthwork
 - 6. Section 31 23 16 - Excavation
 - 7. Section 31 23 17 - Trenching
 - 8. Section 31 23 23 - Fill
 - 9. Section 33 30 10.13 - Sewer and Manhole Testing
 - 10. Section 33 05 13 - Manholes

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International (ASTM):
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 5. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
 6. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
 7. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 8. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 9. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 10. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 11. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 12. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 13. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
15. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
16. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
17. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

C. American Water Works Association (AWWA):

1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
3. AWWA C110 - Ductile-Iron and Gray-Iron Fittings.
4. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
5. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
6. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
7. AWWA C153 - Ductile-Iron Compact Fittings.
8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

1.3 COORDINATION

- A. Notify affected utility companies at least 72 hours prior to construction.

1.4 SUBMITTALS

- A. Product Data: Submit Manufacturer catalog cuts and other information indicating proposed materials, accessories, details, and construction information.
- B. Shop Drawings:
 1. Indicate layout of sewer system and appurtenances.
 2. Show size, materials, components of system, and burial depth.

- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. The certificate shall be signed by an authorized agent of the Manufacturer.
- D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.
- E. Manufacturer Instructions:
 - 1. Indicate special procedures required to install specified products.
 - 2. Submit detailed description of procedures for connecting new sewer to existing sewer line.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Materials:
 - 1. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.
 - 2. All material of a like kind shall be provided from a single manufacturer unless otherwise approved by the Owner's Representative.
 - 3. All material shall be carefully handled and installed in good working order free from defect in manufacture, storage, and handling.
 - 4. All pipe and fittings shall be manufactured in the United States of America, unless otherwise approved by the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- B. Storage:

1. Store materials according to Manufacturer instructions.
- C. Protection:
1. Protect materials from moisture, dust, and direct sunlight by storing in clean, dry location remote from construction operations areas.
 2. Block individual and stockpiled pipe lengths to prevent moving.
 3. Provide additional protection according to Manufacturer instructions.

1.8 EXISTING CONDITIONS

- A. Field Measurements:
1. Verify field measurements prior to fabrication.
 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 SANITARY SEWERAGE PIPE AND FITTINGS

- A. Plastic Pipe:
1. Material:
 - a. Polyvinyl chloride (PVC), manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454-B.
 - b. At locations indicated in the Drawings, pipe shall conform to AWWA C900.
 2. Fittings: PVC.
 3. Pipe and fittings 4 inches to 15 inches in diameter:
 - a. Comply with ASTM D3034, SDR 35.
 4. Pipe and fittings 18 inches and larger in diameter:
 - a. Comply with ASTM F679, PS46.
 - b. Pipe shall have a minimum stiffness of 46 pounds per square inch (psi).
 5. AWWA C900 Pipe:
 - a. 4 inches to 12 inches in diameter.

- b. DR 25.
- c. Pipe shall have minimum stiffness of 149 psi.
- 6. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.
- 7. Joints:
 - a. Integral bell push-on type: Comply with ASTM D3212.
 - b. For use with AWWA C900 pipe: Integral bell push-on type: Comply with ASTM D3139.
- 8. Gaskets:
 - a. Factory installed.
 - b. Elastomeric gaskets: Comply with ASTM F477.

2.2 FLEXIBLE COUPLINGS

A. Description:

- 1. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.
- 2. Attachment: Two [Series 300] stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Description:

- 1. Material: Ethylene propylene rubber (EPDM).
- 2. Comply with ASTM C923.
- 3. Attachment: Stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

- 1. As specified in Section 03 30 00, Cast-in-Place Concrete.
- 2. Strength: Minimum 3,000 psi at 28 days.
- 3. Air entrained.
- 4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 20 00 - Concrete Reinforcing.

2.5 MANHOLES

A. Description:

1. As specified in Section 33 05 13 - Manholes.
2. Material: Precast concrete.
3. Diameter: As shown in the Drawings.
4. Top: Eccentric cone.
5. Frames and Covers: Watertight cast iron.
6. Cover Inscription: SEWER.

2.6 MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A2, as specified in Section 31 05 16, Aggregates for Earthwork.
2. Pipe Zone Backfill: Coarse Aggregate Material Type A2, as specified in Section 31 05 16, Aggregates for Earthwork.
3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A6, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2.7 MIXES

A. Grout: As specified in Section 03 60 00, Grouting.

2.8 ACCESSORIES

A. Underground Pipe Markers: As specified in Section 31 23 17, Trenching.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut, or excavation base is ready to receive Work.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over-excavation in accordance with Section 31 23 17, Trenching.
- B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.
- C. Protect and support existing sewer lines, utilities, and appurtenances.
- D. Utilities:
 - 1. Maintain profiles of utilities.
 - 2. Coordinate with other utilities to eliminate interference.
 - 3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

- A. Bedding:
 - 1. Excavate pipe trench as specified in Section 31 23 17, Trenching.
 - 2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of utility.
 - 3. Pipe base shall be observed by Engineer prior to placement of the pipe.
 - 4. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
 - 5. Provide sheeting and shoring as specified in Section 31 50 00.
 - 6. Placement:
 - a. Place bedding material at trench bottom.
 - b. Level materials in continuous layer not exceeding 6 inches compacted depth.
 - c. Compact to 95 percent of maximum density.

B. Piping:

1. Install pipe, fittings, and accessories according to standards listed below, and seal joints watertight.
 - a. PVC: Comply with ASTM D2321.
 - b. Ductile Iron: Comply with AWWA C600.
 - c. Reinforced Concrete: Comply with ASTM C1479.
2. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
3. Lay pipe to slope gradients and line as indicated on Drawings.
4. Variations:
 - a. Maximum Variation from Indicated Line: 1/32-inch per inch of pipe diameter, but no more than 1/2-inch, providing that such variation does not result in a level or reverse-sloping invert.
 - b. Maximum Variation from Indicated Grade: 1/32-inch per inch of pipe diameter, but no more than 1/4-inch.
 - c. Variation in the invert elevation between adjoining ends of pipe, include fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.
5. Begin at downstream end and progress upstream.
6. Assemble and handle pipe according to Manufacturer's instructions, except as may be modified on Drawings or by Engineer.
7. Make straight field cuts without chipping or cracking pipe.
8. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.
9. Assemble pipe joints in accordance with Manufacturer's recommendations/specifications.
10. Cap open ends during periods of Work stoppage.
11. Lay bell and spigot pipe with bells upstream.
12. Backfill and compact as specified in Section 31 23 17, Trenching.

13. Do not displace or damage pipe when compacting.

14. Pipe Markers: As specified in Section 31 23 17, Trenching.

C. Joints:

1. Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean, and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap.
2. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned.
3. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the Pipe Manufacturer.
4. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced.
5. The pipe is then forced "home" firmly and fully.
6. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.

D. Connection to Existing Manholes:

1. Drilling:
 - a. Core drill existing manhole to clean opening.
 - b. Use of pneumatic hammers, chipping guns, and sledgehammers are not permitted.
2. Install watertight neoprene gasket and seal with non-shrink concrete grout.
3. Prevent construction debris from entering existing sewer line when making connection.

E. Manholes:

1. Install manholes as specified in Section 33 05 13, Manholes and Structures.

F. Wye Branches and Tees:

1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.

2. Use standard fittings of same material and joint type as sewer main.
 3. Maintain minimum 5-foot separation distance between wye connection and manhole.
 4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.
 5. Mount saddles with solvent cement or gasket and secure with metal bands.
 6. Lay out holes with template and cut holes with mechanical cutter.
- G. Sanitary Laterals:
1. Construct laterals from wye branch to terminal point at right-of-way or where otherwise shown in the Drawings.
 2. Where depth of main pipeline warrants, construct riser-type laterals from wye branch.
 3. Minimum Depth of Cover over Piping: 2 feet.
 4. Minimum Separation Distance between Laterals: 5 feet.
 5. Install watertight plug, braced to withstand pipeline test pressure thrust, at termination of lateral.
 6. Marker Stake:
 - a. Install temporary marker stake extending from end of lateral to 12 inches above finished grade.
 - b. Paint top 6 inches of stake with fluorescent orange paint.
- H. Backfilling:
1. Backfill around sides and to top of pipe as specified in Section 31 23 23, Fill.
 2. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to and immediately after placing bedding.
- B. Testing:

1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.
2. Pipe Testing: As specified in Section 33 30 10.13, Sewer and Manhole Testing.
3. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

3.5 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 41 10
STORM UTILITY DRAINAGE PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes pipe materials and accessories normally used with gravity storm drainage sewers.

- B. Section includes:
 - 1. Storm drainage piping
 - 2. Piping accessories
 - 3. Connection to existing manholes
 - 4. Catch basins and area drains
 - 5. Cleanouts
 - 6. Bedding and cover materials

- C. Related Sections:
 - 1. Section 03 11 00 – Concrete Work
 - 2. Section 03 62 00 – Non-Shrink Grout
 - 3. Section 31 05 13 - Soils for Earthwork
 - 4. Section 31 05 16 - Aggregates for Earthwork
 - 5. Section 31 23 16 - Excavation
 - 6. Section 31 23 17 - Trenching
 - 7. Section 31 23 23 - Fill
 - 8. Section 33 30 10.13 - Sewer and Manhole Testing
 - 9. Section 33 05 13 - Manholes

1.2 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
- B. ASTM International (ASTM):
1. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings.
 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 3. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 4. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 5. ASTM C913 - Standard Specification for Precast Concrete Water and Wastewater Structures.
 6. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
 7. ASTM C1479 - Standard Practice for Installation of Precast Concrete Sewer, Storm Drain, and Culvert Pipe Using Standard Installations.
 8. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)).
 9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 10. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 11. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 12. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 13. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
 14. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

15. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 16. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 17. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
 18. ASTM F679 - Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- C. American Water Works Association (AWWA):
1. AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 2. AWWA C105 - Polyethylene Encasement for Ductile-Iron Pipe Systems.
 3. AWWA C111 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 4. AWWA C150 - Thickness Design of Ductile-Iron Pipe.
 5. AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast.
 6. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.

1.3 COORDINATION

- A. Notify affected utility companies at least 72 hours prior to construction.

1.4 SUBMITTALS

- A. In accordance with Section 01 33 00, Submittal Procedures.
- B. Product Data: Submit Manufacturer catalog cuts and other information indicating proposed materials, accessories, details, and construction information.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements. The certificate shall be signed by an authorized agent of the Manufacturer.
- D. Test and Evaluation Reports: Submit reports indicating field tests made and results obtained.
- E. Manufacturer Instructions:

1. Indicate special procedures required to install specified products.
 2. Submit detailed description of procedures for connecting new storm sewer to existing storm sewer line.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record invert elevations and actual locations of pipe runs, connections, manholes, and cleanouts.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.
- B. Storage:
 1. Store materials according to Manufacturer instructions.
- C. Protection:
 1. Protect materials from moisture, dust, and direct sunlight by storing in clean, dry location remote from construction operations areas.
 2. Block individual and stockpiled pipe lengths to prevent moving.
 3. Provide additional protection according to Manufacturer instructions.

1.7 EXISTING CONDITIONS

- A. Field Measurements:
 1. Verify field measurements prior to fabrication.
 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 STORM DRAINAGE PIPING

- A. Polyvinyl Chloride (PVC) Pipe:

1. Material:
 - a. Manufactured from rigid polyvinyl chloride compounds conforming to ASTM D1784, Class 12454.
 - b. At locations indicated in the Drawings, pipe shall conform to AWWA C900.
 2. Pipe and fittings 4 inches to 15 inches in diameter, non-pressurized:
 - a. Comply with ASTM D3034, SDR 35.
 3. Pipe and fittings 18 inches and larger in diameter, non-pressurized:
 - a. Comply with ASTM F679, PS46.
 - b. Pipe shall have a minimum stiffness of 46 pounds per square inch (psi).
 4. AWWA C900 Pipe:
 - a. At locations shown in the Drawings.
 - b. Four inches to 12 inches in diameter.
 - c. DR 25.
 - d. Pipe shall have minimum stiffness of 129 psi.
 5. End Connections: Bell and spigot style, with rubber-ring-sealed gasket joint.
 6. Joints:
 - a. Integral bell push-on type: Comply with ASTM D3212.
 - b. For use with AWWA C900 pipe: Integral bell push-on type comply with ASTM D3139.
 7. Gaskets:
 - a. Factory installed.
 - b. Elastomeric gaskets: Comply with ASTM F477.
- B. High Density Polyethylene (HDPE) Pipe:
1. Double wall, ribbed pipe with smooth interior.
 2. Solid pipe, perforated pipe, and fittings shall meet the requirements of ASTM F 405 and F 667

3. Pipe 3 inches to 10 inches in diameter: Comply with AASHTO M 252.
4. Pipe 12 inches to 60 inches in diameter: Comply with AASHTO M 294.
5. Joints: Integral bell push-on type.
6. Manufacturers:
 - a. ADS, N-12 with ProLink joints, or equal.

2.2 FLEXIBLE COUPLINGS

A. Description:

1. Resilient chemical-resistant elastomeric polyvinyl chloride (PVC) coupling.
2. Attachment: Two Series 300 stainless-steel clamps, screws, and housings.

2.3 FLEXIBLE PIPE BOOT FOR MANHOLE PIPE ENTRANCES

A. Description:

1. Material: Ethylene propylene rubber (EPDM).
2. Comply with ASTM C923.
3. Attachment: Stainless-steel clamp and hardware.

2.4 CONCRETE ENCASEMENT AND CRADLES

A. Concrete:

1. As specified in Section 03 11 00, Concrete Work.
2. Strength: Minimum 3,000 psi at 28 days.
3. Air entrained.
4. Finish: Rough troweled.

B. Concrete Reinforcement: As specified in Section 03 11 00, Concrete Work.

2.5 MANHOLES

A. Description:

1. As specified in Section 33 05 13 - Manholes and Structures.

2. Material: Reinforced precast or cast-in-place concrete.
3. Diameter: As shown in the Drawings.
4. Top: Eccentric cone.
5. Frames and Covers: Watertight cast iron.
6. Cover Inscription: DRAIN.

2.6 CATCH BASINS AND AREA DRAINS

A. Construction:

1. Material: Reinforced precast concrete pipe sections.
 - a. Minimum compressive strength of 3,000 psi at 28 days.
 - b. Precast concrete inlets shall conform to ASTM C913.
2. Joints: Lipped male/female.
3. Nominal Interior Dimensions: As shown in the Drawings.

B. Lids and Frames:

1. Materials: Cast iron.
2. Lid:
 - a. Removable.
 - b. Design: Linear grill.
3. Nominal Lid and Frame Size: As shown in the Drawings.

2.7 CLEANOUTS

A. Construction:

1. Per details provided in the Drawings.

B. Lids and Frames:

1. Materials: Cast iron. Meet H-20 load requirement.

2.8 MATERIALS

A. Bedding and Cover:

1. Pipe Bedding: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
2. Pipe Zone Backfill: Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
3. Trench Backfill from Pipe Zone to Finish Grade:
 - a. Material type varies by location, as shown in the Drawings.
 - b. Coarse Aggregate Material Type A1, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.
 - c. Coarse Aggregate Material Type A4, as specified in Section 31 05 16, Aggregates for Earthwork. Aggregate size as shown in the Drawings.

2.9 MIXES

- A. Grout: As specified in Section 03 62 00, Non-Shrink Grout.

2.10 ACCESSORIES

- A. Underground Pipe Markers: As specified in Section 31 23 17, Trenching.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that trench cut, or excavation base is ready to receive Work.
- B. Verify that excavations, dimensions, and elevations are as indicated on Drawings.

3.2 PREPARATION

- A. Correct over-excavation in accordance with Section 31 23 17, Trenching.
- B. Remove large stones or other hard materials that could damage pipe or impede consistent backfilling or compaction.
- C. Protect and support existing sewer lines, utilities, and appurtenances.
- D. Utilities:

1. Maintain profiles of utilities.
2. Coordinate with other utilities to eliminate interference.
3. Notify Engineer if crossing conflicts occur.

3.3 INSTALLATION

A. Bedding:

1. Excavate pipe trench as specified in Section 31 23 17, Trenching.
2. Excavate to lines and grades as indicated on Drawings, or as required to accommodate installation of utility.
3. Pipe base shall be observed by Engineer prior to placement of the pipe.
4. Dewater excavations to maintain dry conditions and to preserve final grades at bottom of excavation.
5. Provide sheeting and shoring as specified in Section 31 50 00.
6. Placement:
 - a. Place bedding material at trench bottom.
 - b. Level materials in continuous layer not exceeding 6 inches compacted depth.
 - c. Compact to 95 percent of the Standard Proctor maximum density by AASHTO T-99.

B. Piping:

1. Install pipe, fittings, and accessories according to standards listed below, and seal joints watertight.
 - a. PVC, HDPE, ABS: Comply with ASTM D2321.
2. Lift or roll pipe into position. Do not drop or drag pipe over prepared bedding.
3. Lay pipe at constant grade between existing connection points.
4. Variations:
 - a. Maximum Variation from Indicated Line: 1/32-inch per inch of pipe diameter, but no more than 1/2-inch, providing that such variation does not result in a level or reverse-sloping invert.

- b. Maximum Variation from Indicated Grade: 1/32-inch per inch of pipe diameter, but no more than 1/4-inch.
 - c. Variation in the invert elevation between adjoining ends of pipe, include fittings, shall not exceed 1/64-inch per inch of pipe diameter, or 1/2-inch maximum.
 5. Begin at downstream end and progress upstream.
 6. Assemble and handle pipe according to Manufacturer's instructions, except as may be modified on Drawings or by Engineer.
 7. Make straight field cuts without chipping or cracking pipe.
 8. Keep pipe and fittings clean until Work has been completed and accepted by Engineer.
 9. Assemble pipe joints in accordance with Manufacturer's recommendations/specifications.
 10. Cap open ends during periods of Work stoppage.
 11. Lay bell and spigot pipe with bells upstream.
 12. Backfill and compact as specified in Section 31 23 17, Trenching.
 13. Do not displace or damage pipe when compacting.
 14. Pipe Markers: As specified in Section 31 23 17, Trenching.
- C. Joints:
1. Just prior to joining the pipes, the surfaces of the joint rings shall be wiped clean, and the joint rings and rubber gaskets shall be liberally lubricated with an approved type of vegetable oil soap.
 2. The spigot end, with the gasket placed in the groove, shall be entered into the bell of the pipe already laid, making sure that both pipes are properly aligned.
 3. Before the joint is fully "home," the position of the gasket in the joint shall be determined by means of a suitable feeler gauge supplied by the Pipe Manufacturer.
 4. If the gasket is found not to be in proper position, the pipes shall be separated, and the damaged gasket replaced.
 5. The pipe is then forced "home" firmly and fully.

6. In its final position, the joint between the pipes shall not be deflected more than 1/2-inch at any point.
- D. Connection to Existing Manholes:
1. Drilling:
 - a. Core drill existing manhole to clean opening.
 - b. Use of pneumatic hammers, chipping guns, and sledgehammers are not permitted.
 2. Install watertight neoprene gasket and seal with non-shrink concrete grout.
 3. .
- E. Manholes:
1. Install manholes as specified in Section 33 05 13, Manholes.
- F. Wye Branches and Tees:
1. Concurrent with pipe-laying operations, install wye branches and pipe tees at locations indicated on Drawings.
 2. Use standard fittings of same material and joint type as sewer main.
 3. Maintain minimum 5-foot separation distance between wye connection and manhole.
 4. Use saddle wye or tee with stainless-steel clamps for taps into existing piping.
 5. Mount saddles with solvent cement or gasket and secure with metal bands.
 6. Lay out holes with template and cut holes with mechanical cutter.
- G. Catch Basins
1. Form bottom of excavation clean and smooth, and to indicated elevation.
 2. Cast-in-place Concrete Construction:
 - a. Form and place cast-in-place concrete base pad, with provision for storm sewer pipe end sections.
 - b. Level top surface of base pad.
 - c. Sleeve concrete shaft sections to receive storm sewer pipe sections.

- d. Establish elevations and pipe inverts for inlets and outlets as indicated on Drawings.
 3. Mount lid and frame level in grout, secured to top cone section to indicated elevation.
- H. Backfilling:
1. Backfill around sides and to top of pipe as specified in Section 31 23 23, Fill.
 2. Maintain optimum moisture content of bedding material as required to attain specified compaction density.

3.4 FIELD QUALITY CONTROL

- A. Request inspection by Engineer prior to and immediately after placing bedding.
- B. Testing:
1. If tests indicate that Work does not meet specified requirements, remove Work, replace, and retest.
 2. Pipe Testing: As specified in Section 33 30 10.13, Sewer and Manhole Testing.
 3. Compaction Testing: See Section 31 23 17, Trenching for Compaction Testing requirements for piping trenches.

3.5 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

DIVISION 40 – PROCESS INTEGRATION

**SECTION 40 05 13
COMMON WORK RESULTS FOR PROCESS PIPING**

PART 1 GENERAL

1.1 SUMMARY

This Section applies to the furnishing and installation of piping inside a building, structure, enclosure piping and miscellaneous yard piping.

A. Related Sections:

1. Section 05 50 00, Metal Fabrications
2. Section 09 90 00, Painting and Coating
3. Section 31 23 17, Trenching
4. Section 33 11 10, Water Utility Distribution and Transmission Piping
5. Section 33 05 17, Precast Concrete Valve Vaults and Meter Boxes.
6. Section 33 13 00, Testing and Disinfection of Water Utility Piping

1.2 REFERENCE STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME B1.20.1 Pipe Threads, General Purpose (inch)
2. ASME A13.1 - Scheme for the Identification of Piping Systems.
3. ASME B16.5 Pipe Flanges and Flanged Fittings, Steel Nickel Alloy, and other Special Alloys
4. ASME B16.15 - Cast Copper Alloy Threaded Fittings: Classes 125 and 250.
5. ASME B31.3 - Process Piping.
6. ASME B31.9 - Building Services Piping.

B. ASTM International (ASTM):

1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 6,000 psi Tensile.

3. ASTM A325 - Specification for High-Strength Bolts for Structural Steel Joints.
 4. ASTM B43 - Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 5. ASTM B88 - Standard Specification for Seamless Copper Water Tube.
 6. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
 7. ASTM D792 - Test Methods for Specific Gravity and Density of Plastics by Displacement.
 8. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 9. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 10. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 11. ASTM D2000 - Classification System for Rubber Products in Automotive Applications.
 12. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 13. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings.
 14. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- C. American Water Works Association (AWWA):
1. AWWA C200 - Steel Water Pipe - 6 In. (150 mm) and Larger.
 2. AWWA C207 - Steel Pipe Flanges for Water Works Service, Sizes 4 in through 144 in.
 3. AWWA C219 - Bolted, Sleeve-Type Couplings for Plain-End Pipe.
 4. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 5. AWWA C510 - Double Check Valve Backflow Prevention Assembly.
 6. AWWA C511 - Reduced-Pressure Principal Backflow Prevention Assembly.

7. AWWA C606 - Grooved and Shouldered Joints.
 8. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution.
- D. American Welding Society (AWS):
1. AWS D1.1 - Structural Welding Code.
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry:
1. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.
- F. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects.
 2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

- A. Coordinate installation of specified items with installation of valves and equipment.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
1. Submit Manufacturer catalog information for each product specified.
- C. Shop Drawings:
1. Identification:
 - a. Submit list of wording, symbols, letter size, and color coding for pipe identification.
 - b. Comply with ASME A13.1.
 2. Provide all necessary dimensions and details on pipe joints, restraints, fittings, fitting specials, valves, appurtenances, design calculations, and material lists.
 3. Provide detailed layout, spool, or fabrication drawings which show all pipe spools, spacers, adapters, connectors, fittings, couplings, and pipe supports necessary to

accommodate the equipment and valves provided in a complete and functional system.

- D. Manufacturer's Statement: Certifying pipe fabrication and products meet or exceed specified requirements.
- E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS and ASME qualification within previous 12 months.
- F. Manufacturer Instructions: Submit special procedures and setting dimensions.
- G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of piping appurtenances.
- B. Identify and describe unexpected variations to pipe routing or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

- A. Drawings:
 - 1. Piping layouts shown in the Drawings are intended to define the general layout, configuration, routing, method of support, pipe size, and pipe type. The mechanical drawings are not pipe construction or fabrication drawings. It is the Contractor's responsibility to develop the details necessary to construct all mechanical piping systems, to accommodate the specific equipment provided, and to provide and install all spools, spacers, adapters, connectors, etc., for a complete and functional system.
- B. Inspection:
 - 1. All pipe shall be subject to inspection at the place of manufacture.
 - 2. During the manufacture of the pipe, the Engineer shall be given access to all areas where manufacturing is in progress and shall be permitted to make all inspections necessary to confirm compliance with the Specifications.
- C. Welding:
 - 1. All welding procedures used to fabricate pipe shall be prequalified under the provisions of ANSI/AWS D1.1.

2. Welding procedures shall be required for, but not necessarily limited to, longitudinal and girth or spiral welds for pipe cylinders, spigot, and bell ring attachments, reinforcing plates and ring flange welds, and plates for lug connections.

D. Welders:

1. Skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used shall do all welding.
2. Welders shall be qualified under the provisions of ANSI/AWS D1.1 by an independent local approved testing agency prior to commencing work on the pipeline.
3. Machines and electrodes similar to those used in the Work shall be used in qualification tests.
4. The Contractor shall furnish all material and bear the expense of qualifying welders.

- E. Tests: Except where otherwise specified, all materials used in the manufacture of the pipe shall be tested in accordance with the applicable Specifications and Standards. Welds shall be tested as specified. The Contractor shall perform all tests at no additional cost to the Owner.

1.8 MATERIAL DELIVERY, STORAGE, AND INSPECTION

A. Inspection:

1. Accept materials on Site in Manufacturer's original packaging and inspect for damage.
2. All piping materials, fittings, valves, and accessories shall be delivered in a clean and undamaged condition.

B. Storage:

1. Store materials according to Manufacturer instructions.
2. Store materials off the ground, to provide protection against oxidation caused by ground contact

C. Protection:

1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.

2. Furnish temporary end caps and closures on piping and fittings and maintain in place until installation.
 3. Provide additional protection according to Manufacturer instructions.
- D. All defective or damaged materials shall be replaced with new materials.

1.9 EXISTING CONDITIONS

- A. Field Measurements:
1. Verify field measurements prior to fabrication.
 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 2. All brass in contact with potable water shall comply with ASTM B584.
- B. Unless specified otherwise or indicated differently in the Drawings, all piping systems and process piping materials shall be as listed in the table below or as shown on the Drawings:

Service	Installation	Material
Drainage/Overflow/ Sanitary Sewer	All	SDR 35 PVC. See Division 33.
Water	Exposed $\geq 4''$	Class 52 Ductile Iron. See Division 33.
	Buried $\geq 4''$	Class 52 Ductile Iron. See Division 33.
	Submerged/Buried < 4''	Stainless Steel - Type 316 Schedule 40 Threaded - ASTM A 312 Fittings Welded or Threaded
	Exposed < 4''	Brass - ASTM B 43, Fittings - Bronze - ASTM B 62 Threaded - ANSI/ASME B 16.15
	Buried < 4''	Copper Tubing - ASTM B88 Type K Soft / Fittings - Wrought Copper - ANSI B16.22, Joints-Soldered
Miscellaneous Pipelines		As shown in the Drawings

2.2 DUCTILE IRON PIPE AND FITTINGS

- A. See Article 2.1.B, Ductile Iron Pipe of Section 33 11 10, Water Utility Distribution and Transmission Piping.

2.3 STEEL PIPE AND FITTINGS

- A. General Service Piping:
 - 1. ASTM A53, seamless, Grade B.
 - 2. Schedule: 40, unless indicated otherwise on Drawings.

2.4 COPPER PIPE AND FITTINGS

- A. Description:
 - 1. Seamless; ASTM B88.
 - 2. Type:
 - a. Type L, hard drawn.
 - b. For pipe under floor slabs, underground or cast in concrete: Type K, annealed, seamless.
- B. Joints:
 - 1. Compression.
 - 2. Manufacturer: Mueller Model 110 or equal
- C. Dissimilar Metals: See Dielectric Unions specified herein.

2.5 BRASS PIPE AND FITTINGS

- A. Pipe: ASTM B43, chrome plated.
- B. Fittings:
 - 1. ASTM B584, brass.
 - 2. ASTM B16.15.
- C. Joints:

1. Mechanical compression.
 2. Threaded: Tapered and smooth threads, ASME B1.20.1 and ASTM B43.
- D. Dissimilar Metals: See Dielectric Unions specified herein.

2.6 POLYVINYL CHLORIDE (PVC) WATER PIPE AND FITTINGS

- A. PVC Pipe and Fittings:
1. Four-inch diameter and smaller:
 - a. Pipe: ASTM D1785, Schedule 40.
 - b. Fittings: ASTM D2466, Schedule 40.
 - c. Joints: Socket, solvent-welded, ASTM D2855.
 - d. Materials: ASTM D1784, minimum cell classification 12545-C.
 2. Six-inch diameter and larger:
 - a. Pipe: AWWA C900, Class 235.
 - b. Fittings: AWWA C111, cast iron.
 - c. Joints: ASTM D3139, compression gasket ring.
 - d. Materials: ASTM D1784, minimum cell classification 12545-C.

2.7 FLEXIBLE TUBING

- A. Polyethylene thermoplastic tubing:
1. Standard weight, conforming to ASTM D1248 Type 1, Class A, Category 4, Grade E5.

2.8 GALVANIZED STEEL PIPE AND FITTINGS

- A. Pipe: Seamless, or electric resistance welded, ASTM A53, Schedule 40.
- B. Joints: Threaded.
- C. Fittings:
1. Threaded, 150-pound malleable iron, galvanized, ASTM A197 or ASTM A47, dimensions conforming to ANSI B16.3.

2. Unions, 300-pound malleable iron, galvanized with dimensions conforming to ANSI B16.3, brass to iron seat.
 3. Thread lubricant shall be Teflon tape or joint compound that is insoluble in water.
- D. Buried Service:
1. Galvanized pipes shall be spirally wrapped with polyvinyl chloride or polyethylene pressure sensitive tape, applied with a suitable primer.
 2. The wrap shall have a nominal thickness of 20 mils, consisting of either one layer of 20-mil tape or two separate layers of 10-mil tape.
 3. Before the primer and wrap is applied, the piping shall be thoroughly cleaned so that all surfaces shall be dry and free of dirt, dust, rust, oil scale, oil, grease, or other foreign matter.
 4. Any solvents used shall be totally volatile so as to leave no trace of oil.
 5. Weld spatters, burrs, or sharp points and edges shall be removed by chiseling, ball peening or filing.
 6. After thorough cleaning, the piping shall be coated with a primer applied in accordance with the Tape Manufacturer's recommendations. Spiral wrappings shall be applied with an overlap of at least 1-inch.

2.9 STAINLESS STEEL TUBING AND FITTINGS

- A. Type 316 stainless steel, unless otherwise specified or shown in the Plans.
- B. Meet the material standards set forth in ASTM A269.
- C. Fittings: ASTM A276 and ASTM A182.
 1. Threaded fittings: National pipe thread meeting the requirements of ASME B1.20.1.
 2. Compression fittings: Two-ferrule, mechanical grip design.
- D. Unions: Provide to facilitate installation and maintenance of tubing.
- E. Manufacturer:
 1. Swagelock, or equal.

2.10 STAINLESS STEEL PIPE AND FITTINGS

- A. Pipe:

1. Size: 4 inches and smaller, schedule 80, type 304, unless otherwise specified.
 2. Conforming to ASME B36.19 dimensions.
 3. Conforming to ASTM A312 material requirements.
- B. Fittings: Conform to ASME B16.11 dimensions and ASTM A182 material requirements.
- C. Threads: Conform to ASME B1.20.1.
- D. Socket welds: Conform to ASME B16.11.

2.11 FLEXIBLE COUPLINGS

- A. Description:
1. Sleeve-type, couplings. Comply with AWWA C219.
 2. Minimum design pressure rating: 150 pounds per square inch (psi).
 3. Middle Ring: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.
 4. Followers: As required for coupling based upon connecting pipe materials, steel, or ASTM A536, ductile iron.
 5. Gaskets:
 - a. Material: Buna-N.
 - b. Comply with ASTM D2000.
 6. Bolts:
 - a. Buried: Steel.
 - b. Submerged: Stainless steel.
 7. Center Pipe Stop: Required where shown on the Drawings.
- B. Finishes:
1. Buried Couplings, Bolts: Factory epoxy coated.
- C. Manufacturers:
1. For ductile iron and steel pipe:

- a. Dresser, Style 38.
 - b. Romac, Model 501.
 - c. Smith-Blair.
2. For PVC pipe:
 - a. Romac, Model 501 or equal.
 3. For flanged steel and ductile pipe:
 - a. Dresser, Style 128 or equal.

2.12 RESTRAINED FLANGE ADAPTERS FOR DUCTILE IRON PIPE

A. Description:

1. ASTM A536, ductile iron.
2. Flange bolt circles compatible with ANSI/AWWA C115/A21.15.
3. Restraint for the flange adapter shall consist of a plurality of individually actuated gripping wedges to maximize restraint capability. Torque limiting actuating screws shall be used to insure proper initial set of the gripping wedges.
4. Capable of deflection during assembly or permit lengths of pipe to be field cut to allow a minimum 0.6-inch gap between the end of the pipe and the mating flange without affecting the integrity of the seal.
5. Safety factor of 2:1 minimum.
6. Manufacturer:
 - a. EBAA Iron, Series 2100 Megaflange or equal.

2.13 FLANGED INSULATING JOINTS

- ### A. Set shall include a full faced gasket, a full-length insulating sleeve for each flange bolt, and two insulating washers and two steel washers for each bolt.
1. Gaskets:
 - a. Full-face, comply with ASME 16.21.
 - b. Non-asbestos and non-phenolic compressed sheet packing with nitrile rubber binder.

- c. Manufacturer: Garlock, Style 3505, or equal.
- 2. Insulating sleeves:
 - a. G-10 glass epoxy.
 - b. Extend the full width of both flanges, except where one flange hole is threaded where the sleeve shall extend through one flange and the gasket.
- 3. Insulating washers:
 - a. G-10 glass epoxy.
 - b. One-eighth-inch thickness.
- 4. Washers:
 - a. Buried: Cadmium plated steel.
 - b. Submerged: Stainless steel.
- B. The complete assembly shall have an ANSI/AWWA pressure rating equal to or greater than that of the flanges between which is installed.
- C. After assembly, the joint shall be tested for continuity. Electrical resistance between flanges and between each bolt and each flange shall be not less than 100,000 ohms.

2.14 INSULATING UNION

- A. Description:
 - 1. Material: Galvanized malleable iron with a ground joint.
 - 2. Iron pipe threads: Conform to ANSI B2.1.
 - 3. Insulations: Nylon, bonded, and molded onto the metal body.
 - 4. Union: Rated for the operating and test pressures of the pipe system.
 - 5. Joint connections to copper alloy pipe and tube shall be copper solder or threaded brass ground joints.
 - 6. Isolation Barrier: Impervious to water.

2.15 BACKFLOW PREVENTERS

- A. Manufacturers:

1. Nibco.
 2. Watts.
- B. Reduced-Pressure Backflow Preventers:
1. Size: 3/4-inch to 2 inches.
 2. Comply with AWWA C511.
 3. Materials:
 - a. Body: Bronze.
 - b. Internal Parts: Bronze.
 - c. Springs: Stainless steel.
 4. Check Valves:
 - a. Quantity: Two, operating independently.
 - b. Spring loaded.
 - c. Third Check Valve: Open under back pressure in case of diaphragm failure.
 5. Differential Pressure Relief Valve:
 - a. Type: Diaphragm.
 - b. Located between check valves.
 6. Ball Valves:
 - a. Type: Full port, resilient seated.
 - b. Quantity: Two.
 - c. Operation: Quarter turn.
 - d. Material: Bronze.
 7. Accessories: Strainer and test cocks.

2.16 DISMANTLING JOINT

- A. Description:

1. Comply with AWWA C219, where applicable.
 2. Self-contained flanged restrained joint fitting, including both flanged components and sufficient harness bars to withstand the imposed thrust.
 3. Design: No part of the restraint system extends outside the flange diameter. The internal bore shall match that of the pipe system.
 4. Dismantling joints will allow for a minimum of 2 inches of longitudinal adjustment.
 5. Furnish as a complete assembly consisting of spigot piece, flange adaptor, tie bars, and gasket.
 6. The gasket seal and compression stud and nut arrangement shall be independent of the tie rod restraint system. Tie Rod diameter shall be compatible with the corresponding bolt diameter of the mating flange. The Tie Rod restraint system shall be capable of withstanding the full pressure thrust that the pipe system can develop at no more than 50 percent of the yield strength of tie rod material.
 7. Pressure Rating:
 - a. Determined by the flange configuration, and all commonly used flanges shall be available.
 - b. Design pressure rating shall be equal to or greater than the mating flanges.
 - c. Dismantling joints will be specially fabricated to accommodate pressure requirements with ANSI B16.5 or ANSI B16.47 300-pound class flanges, depending on size of dismantling joint.
 8. Lining and Coating:
 - a. Shop-applied fusion bonded epoxy coating applied by fluidized bed method, complying with the requirements of NSF 61 and AWWA C550 as applicable.
 - b. As an alternative, a shop-coat primer suitable for field applied coatings can be supplied.
 9. Flanges: Flat-faced, rated to pressure requirements as shown on the Drawings.
 - a. Where design pressure is greater than 300 psi, flanges shall conform to ASME B16.5 and ASME B16.47 300-pound class.
- B. Materials:
1. Spigot piece: Steel, ASTM A283 Grade C.

2. Flange adaptor:
 - a. Up to 12-inch diameter: Ductile iron, ASTM A536 Grade 65-45-12.
 - b. Above 12-inch diameter: Steel, ASTM A283 Grade C.
 3. Tie bars: ASTM A193 Grade B7 threaded rod with rolled threads.
 4. Gasket: EPDM Grade E.
 5. Nuts, Bolts, and Washers: Type 304 stainless steel.
- C. Manufacturer:
1. Romac or equal.

2.17 PIPE SUPPORTS

- A. Floor Support for Pipe:
1. Flanged Pipe Support:
 - a. Construction:
 - 1) Adjustable vertical pipe support, flange plate, extension pipe from base cup to top collar cup with threaded stud.
 - 2) Bolts directly to flange.
 - 3) Anchorable base plate.
 - b. Material: Steel, comply with ASTM A36.
 - c. Finish: Corrosion resistant, electro-galvanized, or prime coated.
 - d. Manufacturers:
 - 1) Standon - Model S89.
 2. Cradle Pipe Support:
 - a. Construction:
 - 1) Adjustable vertical pipe support with saddle strap, extension pipe from base cup to top collar cup with threaded stud.
 - 2) Anchorable base plate.

- b. Material: Steel, comply with ASTM A36.
- c. Finish: Corrosion resistant, electro-galvanized, or prime coated.
- d. Manufacturers:
 - 1) Standon - Model S92.

2.18 PIPE PENETRATIONS

- A. Sleeves for Pipes through Walls and Floors:
 - 1. Material: Galvanized steel.
 - 2. Thickness: Schedule 40.
 - 3. Inside surface of all wall sleeves shall be coated with coal-tar.
 - 4. Annular space between penetrating pipe and wall sleeve shall be filled with an approved permanently flexible sealant.
 - 5. Diameter of wall sleeve shall be as shown in the Drawings.
- B. Mechanical Sleeve Seals:
 - 1. Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
 - 2. Manufacturer: Link-Seal or equal.
- C. Pipes Cast-In Walls and Floors:
 - 1. Material: Ductile iron or steel pipe, as required by the Drawings and the intended service.
 - 2. Diameter: As shown in the Drawings.
 - 3. End Type: As shown in the Drawings.
- D. Seep Rings:
 - 1. Material: 3/8-inch-thick steel plate conforming to ASTM A36, unless otherwise noted.

2. Inside diameter: Equal to the outside diameter of the pipe or sleeve to which it is attached plus 1/4-inch.
3. Outside diameter: As shown in the Drawings.
4. Attach to the pipe or sleeve by means of a continuous seal weld located on both sides of the ring.

2.19 PIPE COATINGS

- A. See Section 09 90 00, Painting and Coating.

PART 3 EXECUTION

3.1 GENERAL

- A. Furnish and install all piping systems shown and specified, in accordance with the requirements of the Contract Documents. Each system shall be complete with all necessary fittings, hangers, supports, anchors, expansion joints, flexible connectors, valves, accessories, heat tracing, insulation, lining and coating, testing, disinfection, excavation, backfill, and encasement, to provide a functional installation.
- B. Pipe shall be installed in accordance with good trade practice. The methods employed in handling and placing of pipe, fittings, and equipment shall be such as to insure that after installation and testing they are in good condition. Should damage occur to the pipe, fitting or equipment, repairs satisfactory to the Engineer shall be made.

3.2 INSTALLATION

- A. Buried Piping Systems:
 1. Establish elevations of buried piping with not less than 3 feet of cover.
 2. Remove scale and dirt from inside of piping before assembly, as may be required.
 3. Excavate pipe trench as specified in Section 31 23 17, Trenching.
 4. Install pipe to accurate lines, elevations, and grades as shown on the Drawings.
 5. Where grades are not shown, pipe shall be laid to grade between control elevations shown on the Drawings.
 6. Place bedding material at trench bottom to provide uniform bedding for piping.
 7. Level bedding material in one continuous layer not exceeding 6 inches compacted depth.

8. Install pipe on prepared bedding.
 9. Route pipe in straight line.
 10. Install pipe to allow for expansion and contraction without stressing of pipe or joints.
 11. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.
 12. Pipe Cover and Backfilling:
 - a. Backfill trench as specified in Section 31 23 17, Trenching.
 13. All buried non-ferrous piping shall be installed with detectable tracer tape.
 - a. Tape shall be buried 12 inches above the top of the pipe or as recommended by Manufacturer.
 - b. Tape shall be continuous and labeled the same as the piping system.
- B. Interior Piping Systems:
1. Install non-conducting dielectric connections wherever joining dissimilar metals.
 2. Establish elevations of buried piping outside valve vault to obtain not less than 3 feet of cover.
 3. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting as specified in Section 09 90 00, Painting and Coating.
 4. Install water piping according to ASME B31.9.
 5. Install unions downstream of valves and at equipment or apparatus connections.
 6. Install brass male adapters each side of valves in copper piped system, solder adapters to pipe.
- C. Backflow Preventer Assemblies:
1. Install backflow preventers of type, size, and capacity indicated.
 2. Comply with applicable code and authority having jurisdiction.
 3. Install airgap fitting on units with atmospheric vent connection.
 4. Pipe relief outlet drain to nearest floor drain.

5. Do not install bypasses around backflow preventers.

D. Pipe Supports and Hangers

1. Install pipe supports according to MSS SP-58 and ASME B31.10.
2. All pipe shall be secured in place by use of blocking, hangers, brackets, clamps or other approved methods, and the weight thereof shall be carried independently of pump casings or equipment.
3. Special hangers and supports are shown on the Drawings.
4. The Contractor shall be responsible for determining the location of and providing all additional supports.
5. Hanger supports shall be as noted below with at least one support adjacent to the joint for each length of pipe, at each change in direction and at each branch connection. Sufficient hangers shall be provided to maintain proper slope without sagging. Support spacing shall not exceed Manufacturer's recommendations, nor as listed below.

<u>Pipe</u>	<u>Maximum Support Spacing (Feet)</u>
Steel Pipe	
Under 3 inches	6
3 inches and Over	12
Cast or Ductile Iron	
Under 4 inches	6
4 inches and Over	12
Stainless Steel and Galvanized Iron	
Under 1-1/2 inches	4
1-1/2 inches to 4 inches	6
Over 4 inches	12
Copper Pipe	6
PVC Pipe	
Under 2-1/2 inches	4
2-1/2 inches and Over	6

6. Spacing of clamps for support of vertical piping shall be close enough to keep the pipe in alignment as well as to support the weight of the piping and contents unless other vertical support is shown, but in no case shall be more than 12 feet.
7. Provide adjustable hangers for all pipes, complete with adjusters, swivels, rods, etc. Size hangers to clear insulation and guide where required, as well as support piping.

All rigid hangers shall provide a means of vertical adjustment after erection. Hanger rods shall be machine threaded. Continuous threaded rods will not be allowed.

8. Clevis or band-type hangers (B-Line FIG B3100) or equal shall be provided as required. Strap hangers not permitted.
9. Provide floor stands, wall bracing, concrete piers, etc., for all lines running near the floors or near walls and which cannot be properly supported or suspended by the walls or floors. Pipelines near concrete or masonry walls may also be hung by hangers carried from wall brackets at a higher level than pipe. Hanging of any pipe from another is prohibited.
10. Equipment shall be positioned and aligned so that no strain shall be induced within the equipment during or subsequent to the installation of pipework.
11. When temporary supports are used, they shall be sufficiently rigid to prevent any shifting or distortion of the piping or related work.

E. Pipe Penetrations:

1. Exterior Watertight Entries: Seal with mechanical sleeve seals or grout, as shown in the Drawings.
2. Whenever a pipeline of any material terminates at or through a structural wall or floor, install piping or sleeve in advance of pouring of concrete required for the particular installation.
3. Plastic pipe shall not be cast in concrete or masonry walls.
4. Set sleeves in position in forms and provide reinforcing around sleeves.
5. Size sleeves large enough to allow for movement due to expansion and contraction and provide for continuous insulation wrapping.
6. Extend sleeves through floors 1-inch above finished floor level and caulk sleeves.
7. Pipe other than concrete, to be cast in water-bearing walls or more than 4 feet below grade shall have seep rings.
8. All buried piping entering structures shall have a flexible connection installed less than 2 feet outside the structure line or as close to the wall as practical.

3.3 CLEANING, TESTING, AND DISINFECTION

- A. Testing and Disinfection: Piping shall be hydrostatically tested, flushed, and disinfected as specified in Section 33 13 00, Testing and Disinfection of Water Utility Piping.

END OF SECTION

**SECTION 40 05 23
COMMON WORK RESULTS FOR PROCESS VALVES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes basic materials and methods related to valves commonly used for process systems, including pump stations and utility vaults and water treatment.

- B. The provisions of this Section shall apply to all valves and valve operators specified in the various Sections of Division 40 of these Specifications except where otherwise specified in the Contract Documents. Valves and operators in particular locations may require a combination of units, sensors, limit switches, and controls specified in other Sections of these Specifications.

- C. Section Includes:
 - 1. Valves.
 - 2. Valve actuators.

1.2 RELATED SECTIONS

- A. Section 03 30 00, Cast-in-Place Concrete.
- B. Section 05 50 00, Metal Fabrications.
- C. Section 09 90 00, Painting and Coating.
- D. Section 33 11 10, Water Utility Distribution Piping.
- E. Section 40 05 13, Common Work Results for Process Piping.
- F. Section 40 05 23.15, Gate Valves.
- G. Section 40 05 23.24, Check Valves.
- H. Section 40 05 23.72, Miscellaneous Valves.

1.3 REFERENCE STANDARDS

- A. American Water Works Association:
 - 1. AWWA C504 - Rubber-Seated Butterfly Valves, 3 In. Through 72 In.
 - 2. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 - 3. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates.
 - 4. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates.
 - 5. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

- B. ASTM International:
 - 1. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 2. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions.
- D. National Electrical Manufacturers Association:
 - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- E. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code (NEC).
- F. NSF International:
 - 1. NSF 61 - Drinking Water System Components - Health Effects.
 - 2. NSF 372 - Drinking Water System Components - Lead Content.

1.4 COORDINATION

- A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 - 1. Submit manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
 - 2. Submit valve cavitation limits.
 - 3. Submit manufacturer data for actuator with model number and size indicated.
- C. Shop Drawings:
 - 1. Submit description of proposed installation, including associated wiring diagrams and electrical data as may be specified elsewhere in the contract documents.

2. Provide assembly drawings indicating parts list, materials, sizes, position indicators, limit switches, actuator mounting, wiring diagrams, and control system schematics.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.
- F. Lining and coating data.
- G. Valve Labeling Schedule: Indicate valve locations and nametag text.
- H. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- I. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- J. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and actuators.
- B. Operation and Maintenance Data: Submit information for valves and actuators.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts:
 1. Furnish one set of manufacturer's recommended spare parts.
- B. Tools:
 1. Furnish special wrenches and other devices required for Owner to maintain equipment.
 2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.8 QUALITY ASSURANCE

- A. Cast manufacturer's name, pressure rating, size of valve and year of fabrication into valve body.
- B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

- C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.
- D. Maintain clearances as indicated on Drawings and Shop Drawings.
- E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first class quality and shall be made by reputable manufacturers.
- F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- B. Store materials according to manufacturer instructions.
 - 1. Store materials in areas protected from weather, moisture, or other potential damage.
 - 2. Do not store materials directly on ground.
- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to manufacturer instructions.
- D. Handle products carefully to prevent damage to interior or exterior surfaces.
- E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

1.10 EXISTING CONDITIONS

- A. Field Measurements:
 - 1. Verify field measurements prior to fabrication.
 - 2. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 VALVES

- A. Description: Valves, operator, actuator, handwheel, chainwheel, extension stem, floor stand, worm and gear operator, operating nut, chain, wrench, and other accessories as required and shown in the Drawings.
- B. Operation:
 - 1. Open by turning counterclockwise; close by turning clockwise.
 - 2. Cast directional arrow on valve or actuator with OPEN and CLOSE cast on valve in appropriate location.
- C. Valve Construction:
 - 1. Bodies: Rated for maximum temperature and pressure to which the valve will be subjected as specified in valve Sections.
- D. Connecting Nuts and Bolts: Stainless steel.

2.3 RESILIENT-SEATED GATE VALVES

- A. As specified in Section 40 05 23.15, Gate Valves.

2.4 VALVE ACTUATORS

- A. All valves shall be furnished with manual actuators, unless otherwise indicated in the Drawings.
- B. Valves in sizes up to and including four inches in diameter shall have direct acting lever or handwheel actuators of the manufacturer’s best standard design.
- C. Actuators shall be sized for the valve design pressure in accordance with AWWA C504.

- D. Provide actuators with position indicators for shutoff valves 6 inches and larger.
- E. Comply with AWWA C541 and C542, where applicable.
- F. Provide fusion epoxy coating and 2 inch operating nut for buried valves as stated in City of Port Orchard Public Works Engineering Standards and Specifications.
- G. Furnish gear operators for valves 8 inches and larger, and chainwheel operators for valves mounted over 7 feet above floor.
- H. Provide gear and power actuators with position indicators.
- I. Gear-Assisted Manual Actuators:
 - 1. Provide totally enclosed gears.
 - 2. Maximum Operating Force: 60 lbf.
 - 3. Bearings: Permanently lubricated bronze.
 - 4. Packing: Accessible for adjustment without requiring removal of actuator from valve.
- J. Handwheel:
 - 1. Furnish permanently attached handwheel for emergency manual operation.
 - 2. Rotation: None during powered operation.
 - 3. Permanently affix directional arrow and cast OPEN or CLOSE on handwheel to indicate appropriate direction to turn handwheel.
 - 4. Maximum Operating Force: 60 lbf.

2.5 SOURCE QUALITY CONTROL

- A. Testing: Test valves according to manufacturer's standard testing protocol, including hydrostatic, seal, and performance testing.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping system is ready for valve installation.

3.2 PREPARATION

- A. Access: All valves shall be installed to provide easy access for operation, removal, and maintenance and to avoid conflicts between valve operators and structural members or handrails.
- B. Valve Accessories: Where combinations of valves, sensors, switches, and controls are specified, it shall be the responsibility of the Contractor to properly assemble and install these various items so that all systems are compatible and operating properly. The relationship between interrelated items shall be clearly noted on shop drawing submittals.

3.3 INSTALLATION

- A. Install valves, actuators, extensions, and accessories according to manufacturer instructions.
- B. Firmly support valves to avoid undue stresses on piping.
- C. Coat studs, bolts, and nuts with anti-seizing lubricant.
- D. Clean field welds of slag and splatter to provide a smooth surface.
- E. Install valves with stems upright or horizontal, not inverted.
- F. Install valves with clearance for installation of insulation and allowing access.
- G. Provide access where valves and fittings are not accessible.
- H. Comply with Division 40 for piping materials applying to various system types.
- I. Valve Applications:
 - 1. Install shutoff and drain valves at locations as indicated on Drawings and as specified in this Section.
 - 2. Install shutoff and isolation valves.
 - 3. Isolate equipment, part of systems, or vertical risers as indicated on Drawings.
 - 4. Install valves for throttling, bypass, or manual flow control services as indicated on Drawings.
- J. Disinfection of Water Piping System:
 - 1. Flush and disinfect system as specified in Section 33 13 00, Testing and Disinfecting of Water Utility Distribution.

3.4 FIELD QUALITY CONTROL

A. Valve Field Testing:

1. Test for proper alignment.
2. If specified by valve Section, field test equipment to demonstrate operation without undue leakage, noise, vibration, or overheating.
3. Engineer will witness field testing.

END OF SECTION

**SECTION 40 05 51.15
GATE VALVES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes gate valves for use in buried service, pump stations, and utility vaults. Coordinate with Section 33 12 16, Water Utility Distribution and Transmission Valves.

- B. Section Includes:
 - 1. Resilient-seated gate valves.

 - 2. General duty gate valves smaller than 3 inches.

- C. Related Sections:
 - 1. Section 33 12 16, Water Utility Distribution and Transmission Valves

 - 2. Section 33 11 10, Water Utility Distribution and Transmission Piping

 - 3. Section 40 05 13, Common Work Results for Process Piping

 - 4. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.

 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.

 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.

 - 4. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).

- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

 - 2. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

3. ASTM B584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
- C. American Water Works Association (AWWA):
1. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service.
 2. AWWA C550 - Protecting Interior Coatings for Valves and Hydrants.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS):
1. MSS SP-70 - Gray Iron Gate Valves, Flanged and Threaded Ends.
 2. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
- E. NSF International (NSF):
1. NSF/ANSI Standard 61 - Drinking Water System Components - Health Effects
 2. NSF/ANSI Standard 372 - Drinking Water System Components - Lead Content

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. As required by Section 33 12 16, Water Utility Distribution and Transmission Valves, and/or Section 40 05 51, Common Requirements Results for Process Valves.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 RESILIENT-SEATED GATE VALVES

- A. Description:
1. Comply with AWWA C509.

2. Minimum Pressure Rating:
 - a. Twelve-inch Diameter and Smaller: 200 pounds per square inch (gauge) (psig).
 - b. Sixteen-inch Diameter and Larger: 150 psig.
 3. End Connections: As shown in the Drawings.
 - a. Standard mechanical joint ends comply with ANSI/AWWA C111.
 - b. Flanged end dimensions and drilling comply with ANSI/ASME B16.1, class 125. Comply with AWWA C115 & ASME 16.5.
 - 1) The Contractor shall coordinate with pipe, valve, and fitting suppliers to make certain pipe, valve, and fitting flanges match in bolt pattern.
 4. Gear Actuators: Conforming to AWWA C509 for manual valves. Provide 2-inch operating nut.
 5. Linings and Coatings:
 - a. Corrosion-resistant fusion bonded epoxy conforming to AWWA C550 and NSF 61.
 - b. All internal and external ferrous surfaces.
 - c. Do not coat flange faces of valves.
 6. Bi-directional flow.
- B. Operation:
1. Non-rising stem.
 2. Open counterclockwise when viewing the valve from above, unless otherwise indicated in the Drawings.
 3. Buried Valves: All buried valves shall be provided with 2-inch square operating nuts.
- C. Materials:
1. Wedge:
 - a. ASTM A126, cast iron or ASTM A536, ductile iron.
 - b. Fully encapsulated with vulcanized SBR rubber.
 2. Body and Bonnet:

- a. ASTM A126, cast iron or ASTM A536, ductile iron.
 3. Stem, Stem Nuts, Glands, and Bushings: ASTM B584, bronze.
 4. Valve Body Bolting: Stainless steel.
- D. Manufacturers:
1. Dresser.
 2. Kennedy.
 3. Approved Equal.

2.3 GENERAL-DUTY GATE VALVES – SMALLER THAN 3 INCHES

- A. Two inches and Smaller:
1. Crane No. 1320, Class 250, or equal.
 2. Body and Trim: ASTM B584, bronze.
 3. Bonnet: Screwed.
 4. Operation: Handwheel.
 5. Inside screw .
 6. Wedge Disc: Solid; ASTM B584, bronze.
 7. End Connections: Threaded.

2.4 SOURCE QUALITY CONTROL

- A. Testing: Test gate valves according to AWWA C509.

PART 3 EXECUTION

3.1 INSTALLATION

- A. As required by Section 33 12 16, Water Utility Distribution and Transmission Valves and/or Section 40 05 51 - Common Requirements Results for Process Valves.
- B. Install according to Manufacturer's instructions.
- C. Support valves in plastic piping to prevent undue stresses on piping.

END OF SECTION

SECTION 40 05 51.24
CHECK VALVES

PART 1 GENERAL

1.1 SUMMARY

- A. Work in this Section includes check valves for use in water facilities. Work includes the furnish and install of all swing and silent check valves, complete, as shown on the Drawings and specified herein, including coating and lining, appurtenances, operators, and accessories.
- B. Section includes:
 - 1. Swing check valves, 4-inch diameter and larger
- C. Related Sections:
 - 1. Section 40 05 51 - Common Requirements Results for Process Valves

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
 - 3. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings.
- B. ASTM International (ASTM):
 - 1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.
 - 4. ASTM B148 - Standard Specification for Aluminum-Bronze Sand Castings.
 - 5. ASTM D1784 - Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.

6. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications.
 7. ASTM D3222 - Standard Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials.
 8. ASTM D4101 - Standard Specification for Propylene Injection and Extrusion Materials.
- C. American Water Works Association (AWWA):
1. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.
- D. NSF International (NSF):
1. NSF 61 - Drinking Water System Components - Health Effects.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. As required by Section 40 05 51, Common Requirements Results for Process Valves.

PART 2 PRODUCTS

2.1 SWING CHECK VALVES, 4-INCH DIAMETER AND LARGER

- A. Description:
 1. Meeting requirements of AWWA C508.
 2. Type: Swing, resilient seated, with outside lever and adjustable spring.
 3. Flow Area: Full open.
 4. Mounting: Horizontal or vertical.
 5. Shall close tightly when the pressure downstream of the valve disc exceeds the upstream pressure.
 6. Working Pressure: 250 psi
 7. Tight sealing, shockless in operation and absolutely prevent the return of water back through the valve.

8. The disc shall be attached to the sic arm by means of a center pin, disc nut, and washer providing 360-degree angular articulation but not rotation.
 9. Pin Shaft:
 - a. Discs shall be suspended from a non-corrosive hinge pin shaft that shall rotate freely without the need for external lubrication.
 - b. The shaft shall be sealed where it passes through the body by means of a stuffing box and adjustable packing.
 10. End Connections: As shown on Drawings. End connections shall be rated to the working pressure requirements specified above.
- B. Materials:
1. Body and Disc: Constructed of heavy cast iron conforming to ASTM A126 class B, or ductile iron conforming to ASTM A536.
 2. Cover: Steel conforming to ASTM A36 or Ductile iron conforming to ASTM A536.
 3. Disc Arm: Ductile iron conforming to ASTM A536.
 4. Body Seat: Type 316 stainless steel or Bronze ASTM B62.
 5. Disc Seat: Field-replaceable, NBR or Buna-N.
 6. Hinge Pin and Key: Stainless steel.
 7. Rubber Components: NBR or Buna-N.
 8. Connecting Hardware: Stainless steel.
- C. Finishes:
1. Epoxy lining and coating conforming to AWWA C210.
 2. For potable water service, epoxy lining and coating shall meet be provided with NSF 61 certification.
- D. Manufacturer:
1. Dresser.
 2. Mueller.
 3. Approved equal.

4.

2.2 SOURCE QUALITY CONTROL

A. Testing:

1. Hydrostatically test check valves at twice rated pressure, in conformance with requirements of AWWA C508.
2. Permitted Leakage at Indicated Working Pressure: None.

PART 3 EXECUTION

3.1 INSTALLATION

- #### A.
- Install check valves according to AWWA C508, Section 40 05 51 Common Requirements Results for Process Valve, and as recommended by Manufacturer.

3.2 SERVICES PROVIDED BY MANUFACTURER'S REPRESENTATIVE

- #### A.
- Provide the services of the Valve Manufacturer's representative to verify proper installation of the valves and to adjust the valves when construction is complete.

END OF SECTION

**SECTION 40 05 67.39
PRESSURE-RELIEF VALVES**

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes the design, manufacture, and testing of 1 in. (25 mm) through 36 in. (900 mm) Control Valves.

1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit Manufacturer catalog information.
- C. Shop Drawings: Indicate materials, size, and accessories
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.3 QUALITY ASSURANCE

- A. Materials in Contact with Potable Water: Certified to NSF Standards 61 and 372.
- B. Standard products – use the same manufacturer for multiple units of same type.

1.4 WARRANTY

- A. Furnish three-year Manufacturer's warranty for pressure-relief valves.

PART 2 PRODUCTS

2.1 PRESSURE RELIEF / SUSTAINING CONTROL VALVES

- A. Function
 - 1. The Pressure Relief / Sustaining Control Valve shall maintain a constant upstream pressure by bypassing or relieving excess pressure and shall maintain close pressure limits without causing surges. Valve will remain closed until the upstream pressure exceeds a pre-determined set point. Valve will be fast opening and modulate to limit the upstream pressure to a pre-determined set point. If upstream pressure decreases below the pilot spring setting, the valve shall close. Valve will be slow closing to prevent surges.
- B. Materials

1. Material specification for the Pressure Relief / Sustaining Control Valves

<u>Component</u>	<u>Material</u>
Body & Cover	Ductile Iron – ASTM A536
Main Valve Trim	Stainless Steel
Disc Retainer	Cast Iron
Diaphragm Washer	Cast Iron
Seat	Stainless Steel
Stem, Nut, and Spring	Stainless Steel
Seal Disc	Burna-N® Rubber
Diaphragm	Nylon Reinforced Burna-N® Rubber
Internal Trim Parts	Stainless Steel; Bronze; Brass
End Detail	Threaded (1”-3”)
Pressure Rating	Class 150 lb. (250 psi max.)
Temperature Range	Water to 180°F
Any other wetted metallic parts	Stainless Steel; Bronze; Brass
Coating	Fusion Bonded Epoxy Coating (Interior and Exterior); ANSI / NSF 61 Approved / AWWA coating specifications C116-03

C. Manufacture

1. Main Valve:

- a. The main valve shall be hydraulically operated, single diaphragm actuated, globe or angle pattern. The valve shall consist of three major components; the body with seat installed, the cover with bearing installed and the diaphragm assembly. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from line pressure. Packing glands, stuffing boxes and/or rolling diaphragm technology will not be permitted and there shall be no pistons operating the main valve or pilot controls. No fabrication or welding shall be used in the manufacturing process. Y-pattern valves shall not be permitted. Main valve shall comply with NSF/ANSI Standard 61 and certified lead free to NSF/ANSI 372 as a saft drinking water system component.

2. Main Valve End Connections:

- a. End Connections for control valve shall be flanged per ASME/ANSI B16.42, Class 150 or Class 300 (1-1/2” thru 36”) or Threaded End Connections (1” thru 3”) or Grooved End Connections (1-1/2” thru 8”).

3. Main Valve Body:

- a. No separate chamber(s) below the diaphragm shall be allowed between the main valve cover and body. No fabrication or welding shall be used in the manufacturing process.
- b. The valve shall contain a resilient, synthetic rubber disc with a rectangular cross-section contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert. No O-ring type discs (circular, square, or quad type) shall be permitted as the seating surface. The disc guide shall be of the contoured type to permit smooth transition of flow and shall hold the discs firmly in place. The disc retainer shall be of a sturdy one-piece design capable of withstanding opening and closing shocks. It must have straight edge sides and a radius at the top edge to prevent excessive diaphragm wear as the diaphragm flexes across this surface. No hours-glass shaped disc retainers shall be permitted, and no V-type or slotted-type disc guides shall be used.
- c. The diaphragm assembly containing a non-magnetic stainless-steel stem; of sufficient diameter to withstand high hydraulic pressures and shall be fully guided at both ends by a bearing in the main valve cover and an integral bearing in the valve seat. The valve seat shall be a solid, one-piece design and shall have a minimum five-degree taper on the seating surface for a positive, drip-tight shut off. No center guides shall be permitted. The stem shall be drilled and tapped in the cover end to receive and affix such accessories as may be deemed necessary. The diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating the operating pressure from the line pressure. No bolts or cap screws shall be permitted for use in the construction of the diaphragm assembly.
- d. The flexible, non-wicking, FDA approved diaphragm shall consist of nylon fabric bonded with synthetic rubber compatible with the operating fluid. The diaphragm's center hole for the main valve stem must be sealed by the vulcanized process or a rubber grommet sealing the center stem hole from the operating pressure. The diaphragm must withstand a Mullins Burst Test of a minimum of 600 X per layer of nylon fabric and shall be cycled tested 100,000 times to insure longevity. The diaphragm shall not be used as the seating surface. The diaphragm shall be fully supported in the valve body and cover by machined surfaces which support no less than one-half of the total surface area of the diaphragm in either the fully opened or fully closed position. Bellofram type rolling diaphragms shall not be permitted.
- e. The main valve seat and stem bearing in the valve cover shall be removable. The cover bearing and seat in the 6" and smaller size valve shall be threaded into the cover and body. The valve seat in the 8" and larger size valves shall be retained by flat head machine screws for ease of maintenance. The lower

bearing of the valve stem shall be contained concentrically within the seat and shall be exposed to the flow on all sides to avoid deposits. To insure proper alignment of the valve stem, the valve body and cover shall be machined with a locating lip. No “pinned” covers to the valve body shall be permitted. Cover bearing, disc retainer and seat shall be made of the same material. All necessary repairs and/or modifications other than replacement of the main valve body shall be possible without removing the valve from the pipeline. The valve shall be designed such that both the cover assembly and internal diaphragm assembly can be disassembled and lifted vertically straight up from the top of a narrow opening/vault. Y-pattern valves shall not be permitted. The seat shall be of the solid one-piece design. Two piece seats or seat inserts shall not be permitted. Packing glands and/or stuffing boxes shall not be permitted.

- 4. Pilot Control System:
 - a. The pressure relief/sustaining pilot shall be a direct-acting, adjustable, spring-loaded, diaphragm valve designed to permit flow when controlling pressure exceeds the adjustable spring setting. The pressure relief pilot control is normally held closed by the force of the compression in the spring above the diaphragm and it opens when the pressure acting on the underside of the diaphragm exceeds the spring setting. Pressure relief pilot control sensing shall be upstream of the pilot system strainer so accurate control may be maintained if the strainer is partially blocked. Pilot shall comply with NSF/ANSI 61 and certified lead free to NSF/ANSI 372 as a safe drinking water system component.
 - b. The pilot control system shall include a strainer, a fixed orifice closing speed and all required control accessories, equipment, control tubing and fittings. No variable orifices shall be permitted. The pilot system shall include an opening speed control on all valves sizes 3” and smaller as standard equipment. The pilot system shall include isolation ball valves on sizes 4” and larger as standard equipment. A full range of spring settings shall be available in ranges of 0 to 400 psi. Pilots to be manufactured by control valve manufacturer.

5. Material Specification for Pilot Control System:

<u>Component</u>	<u>Material</u>
<u>Pressure Relief / Sustaining Pilot Control</u>	
Body & Cover	Stainless Steel
Pilot Trim	Brass & Stainless Steel 303
Rubber	Buna-N®
Connections	FNPT
Pressure Rating	400 psi Max.

Temperature Range	Water to 180°F Max.
<u>Control Tubing</u>	Stainless Steel
<u>Control Fittings</u>	Stainless Steel

6. Factory Assembly:

- a. Each control valve shall be factory assembled.
- b. For all control valves, the factory assembly shall include the complete main valve, pilot valve(s), and all associated ac Each control valve shall be factory assembled.
- c. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008.
- d. For all control valves, the factory assembly shall include the complete main valve, pilot valve(s), and all associated accessories and control equipment.
- e. During factory assembly the control valve manufacture shall make all necessary adjustments and correct any defects.

7. Nameplates:

- a. Each Control Valve and associated pilot(s) shall be provided with an identifying nameplate.
- b. Nameplates, depending on type and size of control valve, shall be mounted in the most practical position possible, typically on the inlet side of the valve body.
- c. Nameplates shall be brass and a minimum of 3/32" thick, ¾" high and 2-3/4" long.
- d. Pertinent control valve data shall be etched or stamped into the nameplate. Data shall include control valve Catalog number, function, size, material, pressure rating, end- connection details, type of pilot controls used and control adjustment range.

8. Factory Testing:

- a. Each control valve shall be factory tested.
- b. The Quality Management System of the factory shall be certified in accordance with ISO 9001: 2008
- c. Tests shall conform to approved test procedures.

- d. The standard factory tests shall include a valve body and cover leakage test, seat leakage test and a stroke test. Control valves and pilot valves, in the partially open position, with both ends closed off with blind flanges (valves) and pipe plugs (pilots), shall be subject to an air test. The applied air pressure shall be 90 psi minimum. All air pressure tests shall be applied for a minimum of 15 minutes. No visible leakage is permitted through the valve seat, the pressure boundary walls of the valve body, valve cover, pilot body, pilot cover or the body-cover joint.
- e. Control valve manufacturer shall, upon request, offer additional testing, such as high-pressure hydrostatic testing, positive material inspection testing, ferrite testing, liquid penetration inspection testing, magnetic particle examination testing and radiographic examination testing.

D. Product Data

1. The following information shall be provided:
 - a. Control Valve manufacturer's technical product data.
 - b. Control Valve manufacturer's Installation, Operation and Maintenance manual (IOM).
2. Provide specific information on all optional features specified above and confirm that these items are provided.
3. The valve manufacturer shall be able to supply a complete line of equipment from 1" through 36" sizes and a complete selection of complementary accessories and equipment.
4. The control valve manufacture shall provide a computerized cavitation analysis report which shows flow rate, differential pressure, and percentage of valve opening. Cv factor, system velocity, and if there will be cavitation damage.
5. The manufacturer must also provide valve noise levels according to International Standards over the flow range of the valve. Noise calculation program will be specific to the control valve manufacturer, and based upon tests conducted by a third party, independent laboratory and will be able to provide dBA values for octave band frequencies between 31.5 and 8000 Hz. (Valves with KO trim calculations are per another industry accepted standard without the octave band frequency noise levels). Generic, third party noise calculation for non-specific control valves will not be accepted.

PART 3 EXECUTION

3.1 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping

1. Control valves specified herein shall be factory assembled. Any control valve appurtenances, accessories, parts and assemblies that are shipped unassembled shall be packaged and tagged in a manner that will protect the equipment from damage and facilitate the final assembly in the field.
2. Care shall be taken in loading, transporting and unloading to protect control valves, appurtenances, or coatings from damage. Equipment shall not be dropped. All control valves and appurtenances shall be examined before installation and no piece shall be installed which is found to be defective. Any damage(s) shall be repaired.
3. Prior to shipping, the control valves and all associated accessories shall be acceptably packaged and covered to prevent entry of foreign material.
4. All packaged control valves shall be shipped, remain covered and stored on site until they are installed and put into use.

3.2 FIELD TESTING

- A. A direct factory representative shall be made available by the equipment supplier for start-up service, inspection and necessary adjustments.

3.3 INSTALLATION

- A. According to Manufacturer instructions and local code requirements.
- B. Repair damaged coatings with material equal to original coating.

END OF SECTION

**SECTION 40 05 71.13
DUCKBILL CHECK VALVES**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flanged-End Duckbill Elastomeric Check Valves.
 - 2. Slip-On Flat Bottom Duckbill Elastomeric Check Valves.
 - 3. Slip-In Inline Elastomeric Check Valves.

1.2 SUBMITTALS

- A. Submit product literature that includes information on the performance and operation of the valve, materials of construction, dimensions and weights, elastomer characteristics, headloss and flow data, and pressure ratings.
- B. Upon request, provide shop drawings that clearly identify the valve dimensions.
- C. Upon request, manufacturer shall provide installation and reference lists for existing valves of similar size and type to the project scope.

1.3 QUALITY ASSURANCE

- A. Supplier shall have at least fifteen (15) years experience in the manufacture of “duckbill” style elastomeric valves.
- B. Manufacturer shall have conducted independent hydraulic testing to determine headloss and jet velocity characteristics on a minimum of eight sizes of duckbill valves ranging from 2” through 48”. The testing must include multiple constructions (stiffness) within each size and must have been conducted for free discharge (discharge to atmosphere) and submerged conditions.
- C. Manufacturer shall have conducted an independent hydraulic test where multiple valves (at least four) of the same size and construction (stiffness) were tested to validate the submitted headloss characteristics and to prove the repeatability of the manufacturing process to produce the same hydraulic characteristics.
- D. Manufacturer to have conducted Finite Element Analysis (FEA) on various duckbill valves to determine deflection, stress and strain characteristics under various load conditions. Modeling must have been done for flowing conditions (positive differential pressure) and reverse differential pressure.

- E. The bill slit of the duckbill valve must be at least 1.57 times the nominal pipe diameter.

PART 2 PRODUCTS

2.1 FLANGED-END DUCKBILL ELASTOMERIC CHECK VALVES

- A. Check Valves are to be all rubber and of the flow operated check type with a flanged end connection. The port area shall contour down to a duckbill which shall allow passage of flow in one direction while preventing reverse flow. The flange and flexible duckbill sleeve shall be one piece rubber construction with nylon reinforcement. The bill portion shall be thinner and more flexible than the valve body, and formed into a curve of 180°.
- B. The flange drilling shall conform to ANSI B16.1 Class 125/ANSI B16.5, Class 150 standards. The valve shall be furnished with galvanized or stainless steel back-up rings for installation.
- C. Manufacturer must have available flow test data from an accredited hydraulics laboratory to confirm pressure drop data. Company name, plant location, valve size and serial number shall be bonded to the check valve.

D. FUNCTION

- 1. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the bill of the valve open, allowing flow to pass. When backpressure exceeds the line pressure, the bill of the valve is forced closed.

E. MANUFACTURER

- 1. All valves shall be of the Series 35 as manufactured by Tideflex Technologies, Carnegie, PA 15106. All valves shall be manufactured in the U.S.A.
- 2. Or approved equal.

2.2 SLIP-ON FLAT BOTTOM DUCKBILL ELASTOMERIC CHECK VALVES

- A. Check Valves are to be all rubber of the flow operated check type with a slip-on connection. The Check Valve is designed to slip over the specified pipe outside diameter and attached by means of vendor furnished stainless steel clamps. The port area shall contour down to a duckbill, which shall allow passage of flow in one direction while preventing reverse flow. The valve shall be one piece rubber construction with nylon reinforcement. The duckbill shall be offset so that the bottom line of the valve is flat, keeping the invert of the pipe parallel with the invert of the valve. The top of the valve shall rise to form the duckbill shape. The bill portion shall be thinner and more flexible than the valve body and formed into a curve of 180°.

- B. Manufacturer must have available flow test data from an accredited hydraulics laboratory to confirm pressure drop data. Company name, plant location, valve size and serial number shall be bonded to the check valve.
- C. FUNCTION
 - 1. When line pressure inside the valve exceeds the backpressure outside the valve, the line pressure forces the bill of the valve open, allowing flow to pass. When backpressure exceeds the line pressure, the bill of the valve is forced closed. The flat bottom allows the valve to be installed where minimal bottom clearance exists.
- D. MANUFACTURER
 - 1. All valves shall be of the Series TF-1 Flat Bottom Type with Curved Bill Sealing Technology ONLY and shall be made in the USA ONLY as manufactured by TideFlex® Technologies, Carnegie, PA 15106.
 - 2. Or approved equal.

2.3 SLIP-IN INLINE ELASTOMERIC CHECK VALVES

- A. Check Valves are to be all rubber and the flow operated check type with slip-in cuff connection. The entire valve shall be ply reinforced throughout the body, saddle and bill, which is cured and vulcanized into a one-piece unibody construction. A separate valve body or pipe used as the housing is not acceptable. The valve shall be manufactured with no metal, mechanical hinges or fasteners, which would be used to secure any component of the valve to a valve housing. The port area of the saddle shall contour into a circumferential sealing area (the "bill") that is concentric with the pipe which shall allow passage of flow in one direction while preventing reverse flow. The entire valve shall fit within the pipe inside diameter. The saddle area of the valve must be flat, not conical, and integral with the rubber body above centerline in order to not produce any areas or voids that can collect or trap debris. The valve must be easily installed in pipes with poor end condition without the need to modify or utilize the headwall or structure to seal and anchor the valve. Once installed, the valve shall not protrude beyond the face of the structure or end of the pipe.
- B. The valve shall incorporate multiple concave grooves molded integrally into the flat saddle wall thickness extending longitudinally a minimum of 80% of the length of the saddle to reduce opening resistance and reduce headloss.
- C. The valve shall incorporate a custom shaped notch in the end of the bill to reduce cracking pressure. The notch shall be at the invert/bottom of the bill and symmetrical about the valve centerline. The longitudinal length of the notch shall be no greater than half the length of the bill.

- D. The outside diameter of the upstream and downstream sections of the valve must be circumferentially in contact with the inside diameter of the pipe.
- E. Slip-in style valves will be furnished with a set of stainless steel expansion clamps. The clamps, which will secure the valve in place, shall be installed in the upstream or downstream cuff of the valve, depending on installation orientation, and shall expand outwards by means of a turnbuckle. Each band shall be pre-drilled allowing for the valve to be pinned and secured into position in accordance with the manufacturer's installation instructions.
- F. Manufacturer must have flow test data from an accredited hydraulics laboratory to confirm pressure drop and hydraulic data.
- G. Company name, plant location, valve size patent number, and serial number shall be bonded to the check valve.
- H. FUNCTION
 - 1. When line pressure exceeds the backpressure, the line pressure forces the bill and saddle of the valve open, allowing flow to pass. When the backpressure exceeds the line pressure, or in the absence of any upstream or downstream pressure, the bill and saddle of the valve is forced closed, preventing backflow.
- I. MANUFACTURER
 - 1. All valves shall be Series CMUF-SL slip-in CheckMate Ultraflex Valves as manufactured by Tideflex Technologies®, A Division of Red Valve Company, Carnegie, PA 15106. All valves shall be manufactured in the U.S.A., PNW REP is ANTEC CORPORATION 425-888-9090.
 - 2. Or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Valve shall be installed in accordance with manufacturer's written Installation and Operation Manual and approved submittals.

3.2 MANUFACTURER'S CUSTOMER SERVICE

- A. Manufacturer's authorized representative shall be available for customer service during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

- B. Manufacturer shall also make customer service available directly from the factory in addition to authorized representatives for assistance during installation and start-up, and to train personnel in the operation, maintenance and troubleshooting of the valve.

END OF SECTION

**SECTION 40 05 78
MISCELLANEOUS VALVES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes miscellaneous valves not included in other Sections for use in buried service and pump stations.
- B. Section Includes:
 - 1. Air release valves.
 - 2. Combination air/vacuum valves.
 - 3. Ball valves, 2 inches and under.
- C. Related Sections:
 - 1. Section 05 50 00, Metal Fabrications
 - 2. Section 09 90 00, Painting and Coating
 - 3. Section 33 11 10, Water Utility Distribution and Transmission Piping.
 - 4. Section 40 05 13, Common Work Results for Process Piping.
 - 5. Section 40 05 51, Common Requirements Results for Process Valves.

1.2 REFERENCE STANDARDS

- A. American Society of Mechanical Engineers (ASME):
 - 1. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 - Metric/Inch Standard.
 - 3. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded.
 - 4. ASME B16.42 - Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300.
 - 5. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
- B. ASTM International (ASTM):

1. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 - Standard Specification for Ductile Iron Castings.
3. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 COORDINATION

- A. Contractor shall be solely responsible to coordinate Work of this Section with piping, equipment, and appurtenances.

1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
 1. Submit Manufacturer's latest published literature. Include illustrations, installation and maintenance instructions, and parts lists.
 2. Submit valve cavitation limits.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit installation instructions and special requirements, including storage and handling procedures.
- E. Lining and coating data.
- F. Valve Labeling Schedule: Indicate valve locations and nametag text.
- G. Certification of Valves Larger than 12 inches: Furnish certified copies of hydrostatic factory tests, indicating compliance with applicable standards.
- H. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- I. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections, including factory-applied coatings.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of valves and actuators.
- B. Operation and Maintenance Data: Submit information for valves.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish one set of Manufacturer's recommended spare parts.

B. Tools:

1. Furnish special wrenches and other devices required for Owner to maintain equipment.
2. Furnish compatible and appropriately labeled toolbox when requested by Owner.

1.7 QUALITY ASSURANCE

A. Cast Manufacturer's name, pressure rating, size of valve, and year of fabrication into valve body.

B. Valve Testing: Each valve body shall be tested under a test pressure equal to twice its design water-working pressure.

C. Certification: Prior to shipment, submit for all valves over 12 inches in diameter, certified, notarized copies of the hydrostatic factory tests, showing compliance with the applicable standards of AWWA, ANSI, ASTM, etc. Valves tested and supplied shall be trackable and traceable by serial number, tagged or otherwise noted on valve, upon arrival to Site.

D. Maintain clearances as indicated on Drawings.

E. Unless otherwise noted, all water works materials provided for the Project shall be new, of first-class quality and shall be made by reputable manufacturers.

F. All material of a like kind shall be provided from a single manufacturer, unless otherwise approved by the Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Inspection: Accept materials on Site in Manufacturer's original packaging and inspect for damage.

B. Store materials according to Manufacturer instructions.

1. Store materials in areas protected from weather, moisture, or other potential damage.
2. Do not store materials directly on ground.

- C. Protection:
 - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
 - 2. Protect valve ends from entry of foreign materials by providing temporary covers and plugs.
 - 3. Provide additional protection according to Manufacturer instructions.
- D. Handle products carefully to prevent damage to interior or exterior surfaces.
- E. All defective or damaged materials shall be replaced with new materials at no cost to the Owner.

PART 2 PRODUCTS

2.1 GENERAL

- A. All materials in contact with potable water shall conform to ANSI/NSF Standard 61 and meet the “lead free” requirements of the Safe Drinking Water Act amendment, effective January 4, 2014, as per the lead content evaluation procedures outlined in NSF/ANSI Standard 372.1.
 - 1. All fittings shall either be cast or permanently stamped with markings identifying the item as complying with NSF 61 per the requirements of NSF 372 for “lead free”.
 - 2. All brass in contact with potable water shall comply with ASTM B584.

2.2 AIR RELEASE VALVES

- A. Description:
 - 1. Inlet Size: 2-inch diameter and smaller.
 - 2. Cast-iron body and cover. Comply with ASTM A126, Class B.
 - 3. Stainless steel orifice and float. Comply with ASTM A240.
 - 4. Design test pressure: 450 psig.
- B. Manufacturers:
 - 1. DeZurik - APCO Series 200A or equal.

2.3 COMBINATION AIR/VACUUM VALVES

A. Description:

1. Construction: Two independent valves: one air/vacuum valve, one air release valve.
2. Inlet Size: Greater than 2-inch diameter.
3. Cast iron body and cover. Comply with ASTM A126, Class B.
4. Stainless steel orifice and float. Comply with ASTM A240.
5. Valves seats: Buna-N.

B. Manufacturers:

1. DeZurik - APCO Series 1700 or equal.

2.4 BALL VALVES, 2 INCHES AND UNDER

A. Description:

1. Four hundred-pound. Water, oil, and gas rating (WOG) with bronze body and trim, unless otherwise shown on the Drawings.
2. Seat ring: Tetrafluoroethylene (TFE).
3. O-ring seals: Fluorocarbon.
4. Three-piece construction so that maintenance can be performed without distributing the valve body after installation.

B. Manufacturer:

1. Nibco T-590-Y or equal.

2.5 SOURCE QUALITY CONTROL

A. Testing Pressure-Reducing and Pressure-Sustaining Valves:

1. Leakage Testing:

- a. Test each assembled valve hydrostatically at 1-1/2 times rated working pressure for minimum five minutes.
- b. Test each valve for leakage at rated working pressure against closed valve.
- c. Permitted Leakage: None.

2. Functional Testing:
 - a. Test each valve to verify specified performance.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install valves per Manufacturer requirements and recommendations.
- B. Install all valves with valve seats level.
- C. Install protective strainers upstream of solenoid valves, pressure-reducing valves, and pressure-sustaining valves.

END OF SECTION

SECTION 40 06 70

SCHEDULES OF INSTRUMENTATION FOR PROCESS SYSTEMS

INSTRUMENT DESCRIPTION	P&ID	SPEC	SIZE	RANGE	NOTES
WELL NO. 11 FLOW METER	I-3	40 71 13	8"	0-1150 GPM	
BOOSTER STATION DISCHARGE FLOW METER	I-3	40 71 13	10"	0-2300 GPM	
CLEARWELL A PRESSURE TRANSMITTER	I-4	40 72 43	N/A		
CLEARWELL B PRESSURE TRANSMITTER	I-4	40 72 43	N/A		
FLUORIDE STORAGE TANK LEVEL METER	I-4	40 72 13 46 20 00	N/A		
HYPOCHLORITE STORAGE TANK LEVEL METER	I-4	40 72 13 46 20 00	N/A		

END OF SECTION

SECTION 40 61 13

PROCESS CONTROL SYSTEM GENERAL PROVISIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This section specifies general requirements which are applicable to providing instrumentation and controls for the process system
- B. The requirements of this section are applicable to all work to be completed by the System Integrator and as specified in all sections of 40 61 XX, 40 63 XX, 40 67 XX, 40 71 XX, 40 72 XX, 40 75 XX, 40 78 XX and 40 80 XX. Where XX refers to any specification section beginning with the preceding section numbers.
- C. Electrical requirements applicable to this work are specified in Division 26.
- D. Section includes:
 - 1. Scope
 - 2. Definitions
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products.
 - 6. Installation.
 - 7. Testing.
 - 8. Manufacturers Services.

1.2 SCOPE

- A. The Owner's Control System Integrator, Technical Systems Inc., shall provide all system integration for this project on this specification section as well as those listed or referenced herein.
 - 1. New primary process measurement devices, instrumentation and new process auxiliary devices.
 - 2. Provide process control system PLC, SCADA and OIT application programming.
 - 3. New SCADA system hardware including digital process controllers (PLC based), IO modules, power modules, communication modules, network switches, UPS, and fiber optic patch panels.

4. New custom control panels, control stations, junction boxes, and control power distribution panels.
 5. Process control system networking.
 6. Modification of existing instrumentation and control for process systems.
 7. Submittal documentation for process systems instrumentation and control including schedules, drawings, product manuals.
 8. Maintaining construction RECORD/AS BUILT of submittal documentation and incorporating interconnection detail from other sections submittals to show accurately process systems instrumentation and control wiring as complete from circuits start and end connections.
 9. Configuration set up, calibration, testing process systems instrumentation and controls.
 10. Training.
 11. Assemble process control hardware into customized fabricated process control panel(s).
 12. Factory test process control panel customized fabrication(s).
 13. Deliver and install process control panel customized fabrication(s) on site.
- B. PROGRAMMING: The System Integrator provides all control system PLC, SCADA and OIT application programming.

1.3 DEFINITIONS

- A. GENERAL: Definitions of terminology related to Instrumentation and Industrial Electronic Systems used in the specifications as defined in IEEE 100, ISA S51.1, and NEMA ICS 1.
- B. VENDOR PACKAGE PROCESS CONTROL SYSTEM: A system of equipment and hardware provided by a vendor used for control, monitoring process conditions, control feedback and process performance for an associated vendor package equipment system which interfaces to the control system.
- C. TWO-WIRE TRANSMITTER: An instrument which derives operating power supply from the signal transmission circuit and requires no separate power supply connections. A two-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit from a 24-volt direct current driving potential and a maximum circuit resistance of 600 ohms. A two-wire transmitter is also referred to as loop powered.

- D. **FOUR-WIRE TRANSMITTER:** An instrument which derives operating power from separate power supply connections. A four-wire transmitter produces a 4 to 20 milliampere current regulated signal in a series circuit with a maximum circuit resistance of 600 ohms. Four-wire transmitters typically require 120Vac or 24Vdc input power supply.
- E. **GALVANIC ISOLATION:** Electrical node having no direct current path to another electrical node. Galvanic isolation refers to a device with electrical inputs and/or outputs which are isolated from ground, the device case, the process fluid, and separate power supply terminals. Inputs and/or outputs may be externally grounded without affecting the characteristics of the devices or providing path for circulation of ground currents.
- F. **PANEL:** An instrument support system which may be a flat surface, a partial enclosure, or a complete enclosure for instruments and other devices used in process control systems including consoles, cabinets and racks. Panels provide mechanical protection, electrical isolation, and protection from dust, dirt, moisture, and chemical contaminants which may be present in the atmosphere.
- G. **DATA SHEETS:** Data sheets shall refer to ISA S20 or ISA TR20.00.01 latest version.
- H. **SIGNAL TYPES:**
 - 1. **LOW-LEVEL ANALOG:** Signal with full output level of 100 millivolts or less including thermocouples and resistance temperature detectors.
 - 2. **HIGH-LEVEL ANALOG:** Signals with full output level greater than 100 millivolts but less than 30 volts, including 4 to 20 mA transmission.
 - 3. **PULSE FREQUENCY:** Counting pulses emitted from speed or flow transmitters.
 - 4. **DISCRETE CONTROL OR EVENTS:** Dry contact closures and signals monitored by solid state equipment, relays, or control circuits typically rated for 120 volts AC or 24 volts DC.
- I. **SYSTEMS INTEGRATOR:** A firm engaged in the business of detailed control system design and engineering, custom panel fabrication, instrumentation component purchase, instrumentation tuning, system and panel assembly, and testing the specified process control and industrial automation systems.
- J. **SYSTEMS PROGRAMMER:** The Systems Programmer, or “Owner’s Programmer”, shall be the System Integrator. The Programmer or Integrator shall provide the programming of the PLC and SCADA application.
- K. **OIT:** Acronym for Operator Interface Terminal

- L. SCADA: Acronym for Supervisory Control and Data Acquisition
- M. PLC: Acronym for Programmable Logic Controller – synonymous with Programmable Automation Controller (PAC) for purposes of this project

1.4 QUALITY ASSURANCE

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
IEEE 100	Standard Dictionary of Electrical and Electronics Terms
ISA S5.4	Instrument Loop Diagrams
ISA S20	Specification Forms For Process Measurement and Control Instrumentation, Primary Elements, and Control Valves
ISA S51.1	Process Instrumentation Terminology
ISA TR20.00.01	Specification Forms for Process Measurement and Control Instruments Part 1: General Considerations
NEMA ICS 1	General Standards for Industrial Control and Systems

1.5 SYSTEMS INTEGRATOR

- A. The City’s Control System Integrator,
 Technical Systems Inc.
 Lynnwood, WA
 (425) 678-4104
 andrewp@tsicontrols.com
 shall provide all system integration for this project.

1.6 SYSTEMS INTEGRATOR RESPONSIBILITY

- A. GENERAL

1. The specified control system and instrumentation integration including new control panels, panel modifications, instrument supply and calibration, testing, startup, operational testing, and training shall be performed by the Systems Integrator.
 2. The control system components shall, as far as practical, be of one manufacturer.
 3. The components, modules, devices, and control system equipment shall be recognized industrial quality products. Recognized commercial or office grade products are prohibited.
 4. The specified system performance shall be demonstrated to and accepted by the Owner and the Engineer.
- B. PRE-SUBMITTAL CONFERENCE:
1. Schedule a pre-submittal conference with the Owner and Engineer within 30-calendar days after Contract award to discuss the work equipment, submittal format, and establish the framework for project coordination and communication.
 - a. Provide materials 10-days prior to the conference:
 - b. Instrument Schedule specified in Section 40 06 70 with manufacturer and model number added.
 - c. Product descriptive literature with a statement that the item is as specified.
 - d. Proposed equal products with comparative listing of the published specifications for the specified item and the proposed item.
 - e. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 2. The pre-submittal conference will not replace the Product and Shop Drawing Submittal review process.
- C. PROCESS EQUIPMENT COORDINATION
1. Systems Integrator shall provide wiring interconnect diagrams for the plant process control system to interface with submitted vendor equipment panels and devices. The wiring diagrams shall be a complete representation of the process control requirements for specific equipment. Systems Integrator coordinates to collect equipment wiring information from other Sections to show a totally wired integrated control system.

2. Integrate, furnish, and install equipment in conformance with the drawings, specifications, and the recommendations of the equipment manufacturer and the related processes equipment manufacturers.
3. Systems Integrator shall obtain manufacturer's technical information for items of equipment not provided with, but directly connected to, the control system. Provide the necessary coordination and components for correct signal interfaces between specified equipment and the control system.
4. Systems Integrator shall coordinate with project subcontractors and equipment suppliers.
5. Systems Integrator shall provide installation supervision for the duration of the project.
6. Conflicts between the plans, specifications, manufacturer/vendor drawings and installation instructions, etc., shall be presented to the Owner for resolution before proceeding.

1.7 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

- b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
- C. Product Data: For each type of device and system:
 - 1. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
 - 2. Provide Seismic calculations for anchoring and support of equipment as required in Section 01 41 20.
 - 3. Manufacturer's installation instruction excerpts that apply to this project:
 - a. Mounting requirements
 - b. Electrical connection diagrams
 - c. Calibration procedures
 - d. Operation and maintenance information
 - e. Warranty information
- D. SUBMITTAL DRAWINGS
 - 1. GENERAL
 - a. Prepare drawings in AutoCAD version 2018 or later with borders and titleblocks identifying the project and system.

- b. Diagrams shall carry a uniform and coordinated set of wire numbers and terminal block numbers.
- c. The drawing numbers and file names are to be based on equipment tag numbers.
- d. Provide the following submittal drawings
 - 1) Arrangement and layout drawings
 - a) Contract document's drawings are typical illustrations of panel hardware/component arrangement and layouts representing one or more than one panel with similar interconnection requirements. Provide the unique panel arrangement, layout and outline drawings. Show arrangement and layout to scale. Add components and wiring to the unique panel drawings as required to complete a fully integrated operation. Include on the drawings a Bill of Material that identifies all components in the arrangement and layout.
 - 2) Schematic diagrams
 - a) Show components of a control panel in an arrangement similar to the actual layout of the panel including internal wiring between devices and IO module layout connections. Show terminal blocks used for internal wiring or field wiring, identified as such.
 - 3) Loop diagrams
 - a) Provide the unique loop diagram for each piece of equipment.
 - 4) Network block diagram
 - a) A network block diagram is a diagram of the control system, with annotated boxes to show the primary network components (controllers, hubs, switches, computers, displays), and annotated interconnecting lines that show the system communication media and communication protocols].

PART 2 PRODUCTS

2.1 GENERAL

A. MATERIALS AND QUALITY:

1. Provide process control hardware new, free from defects, and industrial- grade, as specified. Each type of instrument, instrument accessory, and device used throughout the work shall be manufactured by one firm, where possible.
 2. Electronic process control hardware shall be of solid-state construction with printed or etched circuit boards of glass epoxy of sufficient thickness to prevent warping.
- B. ENCLOSURES: NEMA rating for the location and application shown herein and as specified in Section 40 67 16, 40 67 19, Division 26, and as shown on the drawings.

Location	Enclosure Material and NEMA Rating
Indoor Dry	NEMA 12: mild steel
Indoor Wet	NEMA 12: mild steel when specified with mounting pad or legs for minor splash resistance) or NEMA 4X: 316 Stainless Steel
Outdoor	NEMA 4X: 316 Stainless Steel
Process Corrosive	NEMA 4X: 316 Stainless Steel
Chemical Corrosive	NEMA 4X: 316 Stainless Steel
Hazardous Area:	NEMA 7: Galvanized Malleable Iron or Aluminum or NEMA 4X and UL listed or FM Approved for the Hazardous Area.

2.2 NAMEPLATES

- A. Provide nameplates for all field mounted instrument, analyzer, or equipment. Include the equipment title, the equipment tag number, and power source(s) in the nameplate inscription. Provide machine engraved laminated black phenolic nameplates with white lettering for equipment identification with 1/8-inch high lettering.

2.3 ISOLATION AND SURGE PROTECTION

- A. Surge protect power and output signals for transmitters located outdoors:
1. Signal: Provide internal surge protector as a product option. If transmitter does not include an internal surge protector then provide an external surge protector: Emerson/Rosemount Model 470 D, Emerson/EDCO SS64-036-2, CCI SPN-42 FS28 Series, or approved equal.
 2. AC Power: Provide internal surge protector as a product option. If transmitter does not include an internal surge protector then provide an external surge protector.

External surge protector UL 1449, LED indicator, screw terminal connections, NEMA 4X, EDCO HSP121A or approved equal.

3. Provide a terminal junction box for housing external surge protector. Box to match NEMA rating of the transmitter.
- B.
1. Provide intrinsic safety barrier with two-wire transmitter located in a facility area classified as hazardous per the NEC when instrument is not available as explosion proof (Class I, Division 1) or an alternative protection method recognized by NEC (Class I, Division 2). Require the two-wire transmitter product manufacturer to list intrinsic safety barriers as an acceptable method for installation in a hazardous classified area.
 1. Intrinsic safety barriers for two-wire transmitters to be of the active, isolating, loop powered type. Barrier shall be as recommended by the two-wire transmitter product manufacturer, or accepted equal.

2.4 TRANSMITTER

- A.
1. Comply with the following for primary process measurement transmitters unless specified elsewhere for specific instruments:
 1. Any transmitter that does not include an integral indicator, provide output indicators. Configure indicator display readout, whether integral or separate, in process measuring units over the calibrated range of the transmitter. Display process measurement as a digital LED or LCD readout with process measuring units on the face of the indicator. Provide indicator with accuracy within two percent of span. Provide loop powered unless otherwise specified. Provide output indicator housing with the same NEMA rating as the transmitter, unless otherwise specified.
 2. Operating power derived from the signal transmission circuit for two-wire type transmitters.
 3. Provide load variations within the range of 0 to 600 ohms with the power supply at a nominal 24 volts DC with the default range of 0 to 100% corresponding to 4 to 20 mA dc for the transmitter.
 4. Configure transmitter output to increase with increasing measurement unless otherwise noted.
 5. Galvanically isolate via electro-mechanical or optical technology the transmitter output. If transmitter is not galvanically isolated then provide transmitter output with a loop-powered signal current isolator.

- a. Provide galvanic isolation of milliampere transmission signals from transmitters. Locate isolator inside panel and DIN rail mount. Derive operating power from the signal input circuit or as specified on the drawings.
 - b. Input and output signals 4 to 20 milliamperes with error not exceeding 0.1 percent of span. Input resistance not to exceed 550 ohms with an output load of 250 ohms.
6. Provide transmitter enclosures as rated NEMA 250, Type 4X, unless otherwise specified.

2.5 SPARES:

- A. Provide 10% spare for most components or at least one spare for each panel component unless a larger specific requirement is listed herein.
 1. Power Supplies – 1 of each type used
 2. Terminal Blocks – 5 of each type used
 3. Fuse – 5 of each type used
 4. Circuit Breakers – 2 of each type and size used
 5. Surge Protection Devices – 1 of each type used
 6. Relays – 2 of each type used
 7. Relays Bases – 1 of each type used
 8. UPS - 1 of each type used
 9. PLC Modules – 1 of each type used

PART 3 EXECUTION

3.1 INSTALLATION

A. GENERAL:

1. Install process control hardware in locations that are accessible for operation and maintenance services. Process control hardware not accessible shall be reinstalled at no cost to the Owner.
2. Install process control hardware in accordance with product manufacturer's requirements.
3. Ensure process control hardware is grounded per NEC and manufacturer's requirements.
4. Provide proper clearance for process control hardware for heat dissipation and access.

5. Ensure UL/FM or equal listings/markings/labels are viewable after installation.
6. Provide secure mounting of all process control hardware (such as DIN rail mount).
7. Provide electrical circuit protection for process control hardware if not integral.

B. FIELD EQUIPMENT:

1. Provide equipment with ports and adjustable items accessible for in-place testing and calibration. Install equipment between 50 inches and 60 inches above the floor or permanent work platform. Mount equipment to avoid shock or vibration that may impair operation. Mount equipment for unobstructed access and walkways. Equipment support systems not to be attached to hand- rails, process piping or mechanical equipment.
2. Space instruments and cabinets supported by concrete walls by 5/8 inch using framing channel between instrument or cabinet and wall. Block wall shall have additional installation supports, as required, to avoid damage to the wall. Equipment supports shall be hot-dip galvanized after fabrication or shall be 316L stainless steel, as shown or specified.
3. Design support systems for panels to prevent deformation greater than 1/8 inch in any direction under the attached equipment load and under an external load of 200 pounds.
4. In wet or outdoor areas, conduit penetrations into instrument housing shall be made through the bottom (preferred) or side of enclosures to minimize water entry from around or from inside of conduits. Provide conduit hubs for connections and waterproof mastic for moisture sealant.
5. Provide nameplates for all primary process measurement devices. Attach nameplates to support hardware with a minimum of two self-tapping Type 316 stainless steel screws in a readily visible location, but such that if the field device is changed out, the nameplate will remain to identify the service.
6. The transmitter's output indicator or the switch's status lights must be viewable from floor or permanent work platform without obstruction.
7. Provide configuration equipment including cables and software to communicate with and configure instruments.

C. ELECTRICAL POWER CONNECTIONS:

1. Equipment electric power wiring shall comply with Division 26. Power disconnect switches shall be provided within sight of equipment and labeled to indicate the specific equipment served and the power source location (including circuit breaker

number). "Within sight of" is defined as having an unobstructed view from the equipment served and within 50 feet of the equipment served.

2. Equipment power disconnect switches shall be mounted between 36 inches and 72 inches above the floor or permanent work platform. Where equipment location requirements cannot be met by a single disconnect switch, provide two disconnect switches: one at the equipment and one at the work platform.
3. Provide a surge arrestor on each 120-volt AC disconnect switch serving primary process measurement device located outdoors.

D. CONTROL AND SIGNAL CONNECTIONS:

1. Equipment electric signal connections shall be made on terminal blocks or by locking plug and receptacle assemblies. Flexible cable, receptacle and plug assemblies shall be used where shown or specified.
2. Jacketed flexible conduit shall be used between equipment and rigid race- way systems (Section 26 05 33). Flexible cable assemblies may be used where plug and receptacle assemblies are provided and the installation is not subject to mechanical damage in normal use. The length of flexible conduit or cord assemblies shall not exceed 3 feet except where sufficient length is required to allow withdrawal of instruments for maintenance or calibration without disconnection of conduit or cord assemblies.

3.2 TESTING

- A. DELIVERY INSPECTION: Notify the Owner upon arrival of any material or equipment to be incorporated into the work. Remove protective covers or otherwise provide access in order that the Owner may inspect such items.
- B. REQUIREMENTS: Section 40 61 21.

3.3 MANUFACTURER'S SERVICES

- A. TRAINING: Provide a factory-trained manufacturer's representative or System Integrator skilled in equipment use at the Site for the following activities. Specified durations do not include travel time to or from the Site.
- B. Procedures specified in section 01 75 16.
- C. Provide the services of the manufacturer's representative for a minimum of 2 hours per instruments to evaluate the installation of the instruments, testing and calibration, certification of proper installation, and training.

- D. Training sessions to be of adequate duration to cover the scope of the project. Do not repeat a device training if covered in multiple process areas; provide reference to the training session where the device was covered.
- E. Coordinate training with operations and maintenance staff schedules to ensure all required staff can attend.
- F. Training to include configuration, operation, trouble shooting, wiring, calibration, testing, installation, safety, and warranty coverage for each process control hardware type.
- G. Certify completion of training.

END OF SECTION

SECTION 40 61 21

PROCESS CONTROL SYSTEM TESTING

PART 1 GENERAL

1.1 SUMMARY

- A. This section specifies Contractor and Systems Integrator requirements for testing and documenting the process instrumentation and control system (PICS) for automation integration with SCADA in conjunction with the Owner's Systems Programmer.
- B. The term instrumentation covers field and panel instruments, analyzers, primary sensing elements, transmitters, power supplies, and monitoring devices.
- C. Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate all test procedures with the requirements of Section 01 75 16.
 - 1. Include the following action items
 - a. Develop test plan.
 - b. Develop record keeping system.
 - c. Coordinate testing with Vendor package equipment.
 - d. Coordinate testing with the Owner's Systems Programmer.
- D. Testing to include:
 - 1. Pre-Operational - Factory Acceptance Testing (FAT)
 - 2. Component Testing Sequence:
 - a. Wiring Testing
 - b. Network and Bus Cable System Inspection and Testing
 - c. Piping Testing
 - d. Installation Inspection
 - e. Instrumentation Calibration
 - f. Loop Testing
 - g. Network Testing
 - 3. System (Functional) Testing Sequence:
 - a. Process Control Strategy/Sequence Testing
 - b. Control System Closed Loop
 - c. Functional Checkout

- 4. Operational Testing:
 - a. System Acceptance Testing (SAT)
- E. Definitions: Section 40 61 13 and for definition of System Integrator and Owner's Programmer.

1.2 QUALITY ASSURANCE

A. TESTING MANAGER:

1. The Contractor or Systems Integrator shall appoint a qualified specialist as process control system testing manager to manage, coordinate, and supervise the testing work.
2. The Testing Manager requires at least 5 years of total experience, or experience on at least five separate projects, in managing the testing and startup of electrical and instrumentation control systems of equal or greater scope and complexity. Testing Manager to provide a quality assurance program which includes:
 - a. Definition of process areas and systems, with testing executed on an area by area basis, based on the P&ID drawings.
 - b. Sequential list of the test phases required for each process area and system.
 - c. Completion status tracking form by process area, system, and test phase.

B. REFERENCES: Section 40 61 13.

1.3 SUBMITTALS

A. PROCEDURES: Section 01 33 00.

B. Organize the submittal items in the following manner for review.

1. Qualifications
 - a. Testing Manager Qualifications and resume
 - b. Network testing entity qualifications and staff performing inspections and testing
2. Test Plans and forms
 - a. I/O Interface Summary in accordance with the requirements of paragraph 40 61 21-2.02 D.

- b. Testing status spreadsheet in accordance with the requirements of paragraph 40 61 21-2.02 A. 3.
 - c. Test procedures in accordance with the requirements of paragraph 40 61 21-3.01 D.
 - d. Proposed test forms per PART 3 of this Section 40 61 21, detailed for each test for this project.
 - e. Certified Factory Calibration Reports.
 - f. Provide a copy of this specification and the referenced and applicable sections with addenda updates included with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
 - g. Provide Contractor's adapted version of Section 40 06 70 Schedules of Instrumentation. This list is to be maintained throughout construction to reflect as-built conditions.
3. Factory Acceptance Test Information
- a. Submit location, time, date and duration for Factory Acceptance Testing.
 - 1) Update scheduling of this test periodically. Do not change location and date of test less than two week prior to commencing.
4. Completed Test Forms:
- a. Completed test forms per PART 3. Separate submittals may be provided for each process area.
 - b. List of factory calibrated items and calibration certificates.
 - c. Documentation of network data communication nodes for networked controllers, remote I/O and related devices.
 - d. Final Test Report assembled in a three-ring binder and submitted at the completion of the inspection and testing activities for a facility.
 - 1) Label the binder cover and spine to identify the project name and facility. Test report includes the applicable test procedures for the facility and the completed inspection and test report forms associated with the equipment and systems of that area.

- 2) Organize test results by equipment item or system with individual, labeled tab dividers to identify each. System deficiencies and non-compliant test results identified in the final test report and acknowledged by the responsible party as having been corrected.

PART 2 PRODUCTS

2.1 GENERAL

- A. The Testing Manager shall provide test forms, documentation, and records as specified in the following paragraphs.

2.2 TESTING DOCUMENTATION

- A. DOCUMENTATION RECORDS: The Testing Manager shall develop a records keeping system to document progress and completion for each task in each process area or system. Keep the following current and available for inspection on-site at all times in a location designated by the Owner:
 1. Testing Manager's qualifications, project startup and testing history, including resume as specified in this Section.
 2. List of names of Contractor's and System Integrator's personnel associated with final construction and testing, and normal and emergency contact telephone numbers
 3. Testing Status spreadsheet with breakdown for each process area and process system, with percentage complete on each testing sequence task.
 4. Test Report Volumes.
- B. TEST REPORT VOLUMES: The Contractor develops and maintains testing documentation for each area of the facility in separate volumes. Keep each volume current and available for inspection on-site at all times in a location designated by the Owner. Each volume includes the following as a minimum:
 1. Three-ring binder with front cover and spine labeled: "Testing Documentation For Process Area / Process System" including Owner's name, facility name, project name, and project number.
 2. Table of Contents with same labeling as the volume cover with tabs for each section:
 - a. Section 1 – Control Description

- b. Section 2 – I/O Interface Summary
 - c. Section 3 – Schedules for Integrated Automation Instrumentation and Terminal Devices
 - d. Section 4 – Test Forms
 - e. Section 5 – Certified Factory Calibration Reports
 - f. Section 6 – Final Test Report
- C. I/O INTERFACE SUMMARY: Provide I/O spreadsheets for each area of the facility based on the drawings. Spreadsheets to include the following for each I/O point:
- 1. Signal number/tag
 - 2. Annotation description that may be logically abbreviated and that is subject to approval.
 - 3. Complete physical I/O channel designation and addressing or communication I/O register designation.
 - 4. True/False status designations for digital I/O.
 - 5. Process range; engineering units and any multipliers; and raw signal range count for analog I/O.
 - 6. Signals: Fixed point and scaled at the Controller with minimum four significant implied digits of scaling. E.g.: 0 to 1400 at Controller for a pH range of 0 to 14 at Operator Interface.
 - 7. Provide Operator Interface scaling to display decimal digits required.
 - 8. Test result- pass or fail and date of test.
 - 9. Maintain in Excel with electronic updates to Owner issued within 2 days after each test after any updates or changes by Contractor.
- D. SCHEDULES FOR INTEGRATED AUTOMATION INSTRUMENTATION AND TERMINAL DEVICES: Provide a detailed Schedule for Integrated Automation Instrumentation and Terminal Devices. Use the as-built Schedules for Integrated Automation Instrumentation and Terminal Devices submitted in Section 40 06 70. Provide details on calibration ranges, set points, and dead bands.

PART 3 EXECUTION

3.1 GENERAL

A. GENERAL REQUIREMENTS:

1. Prior to testing, provide notice to the Owner. Provide notice between 60 and 70 days before starting any testing activity, and include a detailed step-by-step test procedure complete with forms for the recording of test results, testing equipment used, and a place for identification of the individual performing or, if applicable, witnessing the test.
2. System integrator to provide detail assistance to the Contractor in generating test forms, customized for this project.

END OF SECTION

SECTION 40 61 26

PROCESS CONTROL SYSTEM TRAINING

PART 1 GENERAL

1.1 SUMMARY

- A. CONTRACTOR shall provide operator training on the operation and maintenance of the control system and all components.
- B. The process instrumentation and control Work for which training is to be provided includes, but is not limited to, the following:
 - 1. Field-mounted instruments and devices.
 - 2. Programmable logic controllers (PLC)
 - 3. Operator interface Terminals (OIT)
 - 4. Local area network hardware and software.
 - 5. Field instruments network communication hardware and software required for interfacing various systems to provide a fully-integrated system.
- C. Coordination
 - 1. Some panels and equipment are furnished under other Specification Sections. Under this Contract the Contractor shall coordinate the training for the use and maintenance of equipment they provide with control equipment provided with packaged equipment and with the PLC and SCADA system programming that will be provided by the OWNER's Programmer. CONTRACTOR shall coordinate with Suppliers of panels and equipment to provide fully functional system complying with the Contract Documents and that interfaces with the process control network.

1.2 SCOPE

- A. Process Instrumentation and Control System Work for which training is to be provided is specified under the control panel and instrumentation Division 40 specifications.

1.3 REFERENCES

- A. Underwriters Laboratory (UL).
- B. National Electrical Manufacturers Association (NEMA).

- C. Instrument Society of America (ISA).
- D. ISA 5.4, Instrument Loop Diagrams.
- E. ISA 20, Specification Forms for Process Measurement & Control Instruments, Primary Elements & Control Valves.
- F. ANSI/ASQ Z1.4, Sampling Procedures and Tables For Inspection By Attributes.
- G. NFPA 79, Electrical Standard for Industrial Machinery.

1.4 SUBMITTALS

- A. Operator Training plan and schedule
- B. Maintenance Training and schedule

1.5 TRAINING

A. General:

1. Provide an integrated training program for Owner's personnel.
2. Perform training to meet specific needs of Owner's personnel.
3. Include training sessions for managers, engineers, operators, and maintenance personnel.
4. Provide instruction on two working shift(s) as needed to accommodate the Owner's personnel schedule.
5. Owner reserves the right to reuse videotapes of training sessions.

B. Operations and Maintenance Training:

1. General:

- a. Refer to specific requirements specified in Div 40 Subsections.
- b. Include review of O&M data and survey of spares, expendables, and test equipment.
- c. Use equipment similar to that provided.
- d. Unless otherwise specified in Process Control System subsections, provide training suitable for instrument technicians with at least a 2-year associate engineering or technical degree, or equivalent education and experience in electronics, instrumentation, or digital systems.

2. Operations Training: For Owner's operations personnel on operation of I&C components.
 - a. Training Session Duration: 1/2 instructor days.
 - b. Number of Training Sessions: Two.
 - c. Location: Project Site.
 - d. Course Objective: Develop skills needed to use I&C components and functions to monitor and control the plant on a day-to-day basis.
 - e. Content: Conduct training on loop-by-loop basis.
 - 1) Loop Functions: Understanding of loop functions, including interlocks for each loop.
 - 2) Loop Operation: For example, adjusting process variable setpoints, AUTO/MANUAL control transfer, AUTO and MANUAL control, annunciator acknowledgement and resetting.
 - 3) Interfaces with Process Control System subsystems.
3. Maintenance Training:
 - a. Training Session Duration: 1/2 instructor days.
 - b. Number of Training Sessions: Two.
 - c. Location: Project Site
 - d. Course Objective: Develop skills needed for routine maintenance of Process Control System.
 - e. Content: Provide training for each type of component and function provided.
 - 1) Loop Functions: Understanding details of each loop and how they function.
 - 2) Component calibration.
 - 3) Adjustments: For example, controller tuning constants, current switch trip points, and similar items.
 - 4) Troubleshooting and diagnosis for equipment and software.
 - 5) Replacing lamps, chart paper, and fuses.

- 6) I&C components removal and replacement.
- 7) Periodic preventive maintenance.

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 FIELD TRAINING

- A. Training sessions to be 1-hour duration and do not repeat a device training if covered in multiple Facility areas; provide reference to the training session where the device was covered. Conduct one training session for each device type per week on two consecutive weeks to accommodate the shift schedules of operation and maintenance staff.
- B. Training to include a demonstration of configuration, operation, trouble shooting, wiring, calibration, testing, installation, safety, and warranty coverage for each device type.

3.2 MANUFACTURER'S SERVICES

- A. TRAINING: Provide a factory-trained manufacturer's representative or System Integrator skilled in equipment use at the Site for the following activities. Specified durations do not include travel time to or from the Site.
- B. Coordinate training with operations and maintenance staff schedules to ensure all required staff can attend.
- C. Training to include configuration, operation, trouble shooting, wiring, calibration, testing, installation, safety, and warranty coverage for each process control hardware type.
- D. Certify completion of training on form provided herein.

END OF SECTION

SECTION 40 62 63

OPERATOR INTERFACE TERMINALS (OIT)

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Product Requirements
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of an Operator Interface Terminal.
- B. Provide and test OIT with programmable logic controller and other process control hardware specified to form a functional process control system.
- C. Provide OIT with screen size as specified on the drawings with sufficient RAM memory to support the visualization programming requirements of the application including screen navigation, alarming, datalogging, etc.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer’s Association
- C. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 67 16 Control Panels and 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00 and 40 61 13.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions.
- E. Operation and Maintenance Manual if applicable.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Candidate manufacturers and models include the following
 - 1. Rockwell Automation\Allen Bradley, Model 2711P-T10C21D8S
 - 2. No substitutions allowed

2.2 ENVIRONMENTAL REQUIREMENTS

- A. Operating Temperature of 32 to 131 degrees F.
- B. Vibration tolerance of 57 to 500 hertz at 2 G peak acceleration
- C. Shock withstand during operation of 15 G at 11 milliseconds
- D. NEMA/UL Type 12, 13, 4X (indoor use) and IEC IP66

2.3 FEATURES

- A. Thin Film Transistor (TFT) Color graphic display
 - 1. Four-wire analog resistive, single touch
 - 2. 18-bit color graphics
 - 3. Brightness: 300 nits minimum
- B. Battery or capacitor backed real time clock (30-day minimum)
- C. SD card memory slot
- D. 512 MB RAM
- E. Windows CE 6.0 or newer operating system.
- F. Battery backed real time clock
- G. Analog resistive Touch screen

2.4 ELECTRICAL REQUIREMENTS

- A. C-UL-us Listed for Class I, Div. 2 Groups A, B, C &D; Class II, Div. 2, Groups F, & G.
- B. Supply Voltage 120 VAC, single phase or 18 – 32 VDC as shown on the drawings

2.5 COMMUNICATION REQUIREMENTS

- A. Communication protocol compatible with the PLC as listed on the drawings.
- B. Ethernet TCP/IP 100 MB and/or serial port as listed on the drawings.
- C. Optional 2-port Ethernet embedded switch
- D. Two USB for peripherals

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and Install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install Operator Interface panel per manufacturer's instructions.
- C. OITs shall be installed at 5'2" to center of screen for finished floor or walkway directly in front of the install location. In the event mounting height is unclear due to other information or situations, Contractor shall submit an RFI to verify desired mounting height before proceeding with installation.
- D. The screens for the operator interface terminal shall be consistent with the layout of the existing operator interface screens within the system. Consult with Owner to provide access to those stations for preview whom may provide a copy of the current programming of one of the stations upon request.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation per manufacturers recommendations

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26

END OF SECTION

SECTION 40 63 43

PROGRAMMABLE LOGIC CONTROLLERS

PART 1 GENERAL

1.1 SUMMARY

- A. Programmable logic process controllers are also known as programmable logic controllers (PLCs) and central processing unit (CPU). This section specifies general requirements for programmable logic process controllers and I/O Modules.
- B. Section includes:
 - 1. Scope
 - 2. Quality Assurance
 - 3. Submittals
 - 4. Performance Requirements
 - 5. Products
 - 6. Installation
 - 7. Testing
 - 8. Manufacturer's Services

1.2 SCOPE

- A. Provide and test programmable logic controller(s) with other process control hardware to create a complete functional control system.
- B. Provide programmable logic process controllers sized for the input/output requirements as specified on the drawings.
- C. The PLCs shall be provided to match the City's existing units for keeping consistency and ease of operation and communication with their existing SCADA system.

1.3 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.4 SUBMITTALS

- A. PROCEDURES: Section 01 33 00 and 40 61 13

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

C. Product Data: For each type of device and system:

1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided

D. Manufacturer's installation instructions.

E. Operation and Maintenance Manual if applicable.

PART 2 PRODUCTS

2.1 CANDIDATE MANUFACTURERS

- A. Rockwell Automation, (Allen-Bradley PLC), CompactLogix System processor unless otherwise specified.

2.2 MATERIALS

- A. Provide new, free from defects, and industrial-grade processor and I/O modules as shown on the drawings.
- B. Provide additional components, including power supplies and cables, as required by the manufacturer.
- C. Provide appropriate screw type terminal connector for each type of I/O module required or listed herein.

2.3 PROCESSOR

- A. Allen-Bradley CompactLogix 5370 L3 Controller, 1769-L33ER

2.4 INPUT/OUTPUT MODULES

- A. Provide input/output modules as shown on the drawings or as required for a complete and functional system.
- B. Unless shown differently on the plans, module types shall be:
 - 1. 16 Point Digital Input Module, 1769-IQ16
 - 2. 16 Point Relay Output Module, 1769-OW16
 - 3. 8 Channel Analog Input Module, 1769-IF8
 - 4. 8 Channel Analog Output Module, 1769-OF8C

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation requirements: Processor and I/O to be rack mounted inside control cabinets as specified in Section 40 67 19 and on the drawings

3.2 TESTING

- A. Testing requirements specified in: Section 40 61 21.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26

END OF SECTION

SECTION 40 66 53

RADIO EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Product Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of the radio. This includes testing, documenting, and start up.
- B. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer's Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ISA – Instrumentation, Systems, and Automation Society.
- G. ICS-1 – General Standards for Industrial Control and System
- H. ICS-2 – Standards for Industrial Control Devices, Controllers and
- I. ICS-3 – Industrial Systems.
- J. UL – Underwriter's Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)
 - 1. Standard 508 (Industrial Control Panels for General Use).
 - 2. Standard 698 (Industrial Control Panels Relating to Hazardous (Classified) Locations)

3. Standard 913 (Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations)
- K. NETA – National Electrical Testing Association.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions.

- E. Operation and Maintenance Manual if applicable.
- F. Warranty information.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Radio candidate manufacturers and models:
 - 1. GE MDS, MCR Orbit LN4 Radio, with both cellular and radio capability
 - 2. Approved equal.

2.2 GENERAL

- A. Product Requirements: The radio shall be provided as a system consisting of the radio, mounted in the control panel, and mounting hardware unless otherwise noted. Radio to be provided with all required ancillary components including interconnecting cables.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and Install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install all components of radio in accordance with manufactures specifications and instructions.
- C. The radio shall be installed, calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- D. CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day for the calibration and testing of the instruments after certification of proper installation.
- E. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed well system.
- F. Install all components in accordance with manufacturer's specifications and as shown on the drawings.
- G. Ensure proper grounding of antennas.

H. Weather proof all exterior coaxial connections.

3.2 TESTING

A. REQUIREMENTS: Section 40 61 21.

B. Ensure proper installation of the radio so as to not be result in false reading or improper operation due to ambient conditions or equipment at the installation site.

3.3 MANUFACTURER'S SERVICES

A. REQUIREMENTS: Section 40 61 13 and 40 61 26

B. The contractor shall provide for a manufacturer's representative to be onsite for 1 day during start-up for the start-up and calibration of the radio.

END OF SECTION

SECTION 40 66 63

ANTENNAS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Installation
 - 7. Testing
 - 8. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of antenna. This includes testing, documenting, and start up.
- B. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Antennas shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. NEMA – National Electrical Manufacturer's Association
- B. NEC – National Electrical Code
- C. NFPA No. 70, NEC - National Electrical Code
- D. ISA – Instrumentation, Systems, and Automation Society.
- E. ICS-1 – General Standards for Industrial Control and System
- F. ICS-2 – Standards for Industrial Control Devices, Controllers and
- G. ICS-3 – Industrial Systems.
- H. UL – Underwriter's Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)
 - 1. Standard 508 (Industrial Control Panels for General Use).
 - 2. Standard 698 (Industrial Control Panels Relating to Hazardous (Classified) Locations)
 - 3. Standard 913 (Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations)

- I. NETA – National Electrical Testing Association.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions.
- E. Operation and Maintenance Manual if applicable.

- F. Warranty information.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Radio Antenna manufacturers:
 - 1. General Electric MDS, Yagi Antenna 450-470 MHz
 - 2. Approved Equal
- B. Cellular Antennas manufactures:
 - 1. PCTEL, Vertical LET Antenna 3 DBI, 50 Ohms
 - 2. Approved equal

2.2 GENERAL

- A. Product Requirements: Provide antennas with all required mounting hardware, coax, connectors, lightning arrestor and mounting mast. The antennas shall be compatible with the specified radio equipment.

2.3 RADIO ANTENNA FEATURES

- A. The antennas will be high gain, heavy duty units made of welded high-grade aluminum (6061-T6). The antenna will connect to the radio through an N male connector to LMR-400 coax. Coax length as required.

2.4 CERTIFICATIONS

- A. Class A digital device compliance
- B. IEEE 802.3 compliant
- C. Meets FIPS 140-2 requirements

2.5 RADIO ANTENNA ELECTRICAL REQUIREMENTS

- A. Bandwidth VSWR 1.5 400MHz: greater than or equal to 38MHz
- B. Power rating: 150 watts
- C. Lightning Protection
- D. Front to back Ratio greater than or equal to 15dB.
- E. Wind loading to 200 mph.

2.6 ACCESSORIES

A. Lightning Arrestor

1. Provide a polyphaser lightning arrestor with the antenna. The unit shall be in line with required adaptors or bulk head mounted through the control panel where acceptable to the environment.

B. Coax

1. Provide LMR-400 coax and adapters are required to connect antenna to the specified radio

2.7 MOUNTING KITS & REQUIREMENTS

- ### A.
1. Provide a heavy-duty mounting bracket to enable the antenna to mount on a 1.5" to 2.5" diameter mast. Mount shall allow for vertical or horizontal polarization.

PART 3 EXECUTION

3.1 INSTALLATION

- ### A.
- REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- ### B.
- Install all components of the antenna in accordance with manufactures specifications and instructions.
- ### C.
- Contractor will schedule a date and time for start-up and will have the following people present.
1. Electrical Contractor
 2. System Integrator
 3. Radio Manufacturer Representative
- ### D.
- The radio and antenna shall be installed and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations.
- ### E.
- CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day for the calibration and testing of the instruments after certification of proper installation.
- ### F.
- In addition, the antenna shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed well system.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation of the radio and antenna so as to not be result in false reading or improper operation due to ambient conditions or equipment at the installation site.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26
- B. The contractor shall provide for a manufacturer's representative to be onsite for 1 day during start-up for the start-up and calibration of the radio and antenna.

END OF SECTION

SECTION 40 67 16

CONTROL PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Panel Information
 - 3. Panel Design
 - 4. Quality Assurance
 - 5. Submittals
 - 6. Performance Requirements
 - 7. Products
 - 8. General

1.2 SCOPE

- A. This section specifies requirements for process control panels and hardware required for custom fabrication.
- B. Provide the instrument, control, and monitoring features indicated on the electrical drawings. Panels shall be arranged to separate control and instrument devices from power wiring. Panel shall be arranged for dedicated field wiring terminations rated for 600 Vac or less for power, control, and instrument signal wiring shall be fabricated by a UL-508A recognized facility and shall bear the appropriate UL 508A Industrial Control Panel label. Panels for Hazardous (Classified) Locations shall bear the appropriate UL 698A label.
- C. Panels that contain programmable logic controllers (PLC) are as shown on the drawings.
- D. Comply with the specified products in Sections 40 61 13. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.
- E. Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.

- F. Refer to Section 26 27 16 that specifies requirements for manufacturer, vendor, and Contractor provided panels that include motor controllers, combination motor starters, control devices, and logic devices as shown on the electrical drawings. These requirements apply to this section as well.
- G. Submittal drawing requirements specified in Section 01 33 00 and 40 61 13.
- H. Label panels with fault current rating per NEC article 409.110.

1.3 REFERENCE STANDARDS

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
 - 1. American National Standards Institute (ANSI).
 - 2. ASTM International (ASTM):
 - a. B75, Standard Specification for Seamless Copper Tube.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 4, Industrial Control and Systems: Terminal Blocks.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 5. Underwriters Laboratories, Inc. (UL):
 - a. 508A, Standard for Safety Industrial Control Panels.
 - b. 913, Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.
 - c. 698A, Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.4 DEFINITIONS

- A. The term "panel" refers to control panels or enclosures listed in the schedule included in this Section.

- B. Foreign Voltages: Voltages that may be present in circuits when the panel main power is disconnected.
 - 1. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.
- C. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- D. Instrumentation Cable:
 - 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
 - 2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded triad) and is used for the transmission of low current or low voltage signals.
- E. Ground Fault Circuit Interrupter (GFCI): A type of device (e.g., circuit breaker or receptacle) which detects an abnormal current flow to ground and opens the circuit preventing a hazardous situation.
- F. Programmable Logic Controller (PLCC): A specialized industrial computer using programmed, custom instructions to provide automated monitoring and control functions by interfacing software control strategies to input/output devices. Synonymous with Programmable Automation Controller (PAC) for purposes of this project
- G. Remote Terminal Unit (RTU): An industrial data collection device designed for location at a remote site, that communicates data to a host system by using telemetry such as radio, dial-up telephone, or leased lines.
- H. Input/Output (I/O): Hardware for the moving of control signals into and/or out of a PLC or RTU.
- I. Supervisory Control and Data Acquisition (SCADA): Used in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by computer workstations.
- J. Digital Signal Cable: Used for the transmission of digital communication signals between computers, PLCs, RTUs, etc.
- K. Uninterruptible Power Supply (DC UPS):
 - 1. A backup power unit that provides continuous power when the normal power supply is interrupted.

2. Provided in each cabinet and panel as indicated by an asterisk (*) in the Panel Schedule in Paragraph 3.05.
 3. Sized to provide a minimum of 8 hours of continuous operation of all connected components.
- L. Provide monitoring and alarm points as shown on the Drawings.
- M. Loop Calibrator: Portable testing and measurement tool capable of accurately generating and measuring 4-20ma DC analog signals.

1.5 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials
- C. Entire assembly shall be affixed with a UL 508A or 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
- D. Each panel shall have an affixed fuse identification list.
- E. Each panel shall have an affixed power and short circuit rating label.

1.6 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with

the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
- b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

C. Submittal items required include:

1. Submit items specified in Section 40 61 13
2. Arrangement and Layout Drawings
3. Exterior panel layout
4. Interior panel layout
5. Bill of Materials
6. PLC I/O list
7. Door-in-door construction devices, where required
8. Sections showing clearances between face and rear mounted equipment.
9. Connection Diagrams.
10. Nameplate engraving schedule:
 - a. Indicate engraving by line
 - b. Character size
 - c. Nameplate size
 - d. Panel and equipment tag number and description
11. Heat load calculations for each cabinet based on the highest ambient temperature for the area in which the subject panel will be located.
12. Power supply calculations.
13. Manufacturer's operation and maintenance information as specified in Section 01 78 23. Manual shall include final reviewed submittal redlined to show AS BUILT conditions; and separate record of all final configuration, jumper, and switch settings.
14. Climate control calculations for each panel

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Enclosures

1. Pentair/Hoffman Enclosures, Inc
2. Saginaw
3. Rittal
4. Hammond Manufacturing
5. Milbank Mfg. Co.

B. Panel Heaters

1. Pentair/Hoffman Enclosures, Inc.
2. Saginaw
3. Rittal
4. Hammond Manufacturing.

C. Ventilation Fans

1. Pentair/Hoffman Enclosures, Inc.
2. Saginaw
3. Rittal
4. Hammond Manufacturing

D. Heater Exchangers

1. Ice Qube, Inc.
2. Hoffman Enclosures, Inc.
3. Rittal.
4. Hammond Manufacturing.

E. Internal corrosion inhibitors:

1. Hoffman Enclosures, Inc.: Model A-HCI.
2. Northern Technologies International Corporation (NTIC):
3. Model Zerust VC.
4. Cortec Corporation: Model VpCI Emitting Systems.

F. Thermostat

1. Pfannenbergl or approved equal.

2.2 FABRICATION

A. General:

1. Fabricate panels with instrument arrangements and dimensions identified in the Contract Documents.
2. Provide panel(s) with the required enclosure rating per NEMA 250 to meet classifications identified in the Contract Documents. Only NEMA Type 4X will be accepted for installation in the field. NEMA 12 will be acceptable in air- conditioned electrical rooms.
3. Devices installed in panel openings shall have a NEMA enclosure rating at least equal to the panel enclosure rating.
4. Short circuit current rating of panel:
 - a. 10,000A, minimum.
5. Panels and pedestals to be located outdoors shall be fabricated from 316 stainless steel and shall utilize appropriate hinge and locking components. Panel(s) shall be completely assembled at the Contractor's factory:
 - a. No fabrication other than correction of minor defects or minor transit damage shall be performed on panels at the jobsite.
6. Painting:
 - a. Panels fabricated from steel shall have their internal and external surfaces prepared, cleaned, primed, and painted:
 - 1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
 - 2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
 - 3) Utilize solvent or chemical methods to clean panel surfaces.
 - 4) Apply surface conversion of zinc phosphate prior to painting to improve paint adhesion and to increase corrosion resistance.
 - 5) Electrostatically apply polyester urethane powder coating to all inside and outside surfaces.
 - 6) Bake powder coating at high temperatures to bond coating to enclosure surface.

- a) Panel interior shall be white with semi-gloss finish.
 - b) Panel exterior shall be ANSI #61 gray with flat finish.
- 7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester urethane powder for wall mounted NEMA 12 rated panels
- b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.
7. Finish opening edges of panel cutouts to smooth and true surface conditions:
- a. Panels fabricated from steel shall have the opening edges finished with the panel exterior paint.
8. Panel shall meet all requirements of UL 508A
- a. If more than one (1) disconnect switch is required to disconnect all power within a panel or enclosure, unless otherwise required by UL 508A, provide a cautionary marking with the words "CAUTION" and the following or equivalent, "Risk of Electric Shock-More than one (1) disconnect switch required to de-energize the equipment before servicing."
9. Provide control panel in accordance with NEC Article 409 - Industrial Control Panels:
- a. In the event of any conflict between NEC Article 409 and UL 508A, the more stringent requirement shall apply.
10. Panel shall meet all requirements of UL 698A
- a. Provide intrinsically safe circuit extensions from panels in unclassified locations into hazardous classified locations in accordance with the NEC as required by UL 698A.
11. Panel door handles shall be lockable with a paddle lock. Verify acceptable shank diameter and lock sizes with SPU.
- B. Wall Mount, Free-Standing or Pedestal-Mounted Panels:
- 1. Welded construction.
 - 2. Completely enclosed, self-supporting and gasketed dust-tight.
 - 3. Rolled lip around all sides of enclosure door opening.

4. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
 5. Full height, fully gasketed flush pan doors.
 6. Full length piano hinges rated for 1.5 times door plus instrument weight.
 7. Doors with 3-point latch and L-shaped, quarter-turn padlockable handles.
 8. Appropriate conduit, wiring, and instrument openings shall be provided.
 9. Lifting eyebolts:
 - a. To allow simple, safe rigging and lifting of panel during installation.
 - b. Removed, holes plugged, and eyebolts stored inside respective enclosure.
 10. Enclosures shall be constructed of a minimum of 12-gauge stainless steel.
 11. Where double doors are provided, provide removable center post.
- C. Internal Panel Lighting and Service Receptacles:
1. One (1) electrical GFCI duplex receptacle for each 3-FT of panel face.
 2. One (1) 12-inch 12 VDC or 30 VDC LED strip light fixture with door-activated switch (es) per FT of panel face. Model: Banner WLB32C570PB with mounting accessories and connectors; or approved equal.
- D. Component Mounting and Placement:
1. Components shall be installed per manufacturer instructions. Double-faced tape will not be permitted.
 2. Control relays and other control auxiliaries shall be mounted on DIN rail mounting channels where practical.
 3. Terminal blocks shall be mounted vertically in the enclosure with ample clearance to allow visual guidance for installing wires.
 4. Front panel devices shall be mounted within a range of 40 to 70 IN above the finished floor or grade, unless otherwise shown in the Contract Documents.
 5. PLC and I/O rack installation:
 - a. Located such that the LED indicators and switches are readily visible with the panel door open.

- b. Located such that calibration, repair and/or replacement of component can be accomplished without the need to remove wire terminations or other installed components.
 - c. Locate power supplies with sufficient spacing for circulation of air.
 - d. Where components such as relays, and other electromagnetic devices are installed within the same enclosure as the PLC system components, provide a barrier of at least 6-inch of separation between the “power area containing the electromagnetic devices” and the “control area”.
6. Components mounted in the panel interior shall be fastened to an interior sub-panel using machine screws:
- a. Fastening devices shall not project through the outer surface of the panel enclosure.
7. Locate and install all devices and components so that connections can be easily made and ample room is provided for servicing each item
- E. Follow UL recommendations.

2.3 INTERNAL WIRING

- A. See Section 40 67 33

2.4 SPARE PARTS

- A. Spare parts are to be provided in accordance with 40 61 13
- B. Tag and store spare parts in accordance with Section 40 61 13.
- C. Provide 20 percent spare contiguous sub-panel area for future expansion.

PART 3 EXECUTION

3.1 TEST PLANS AND REPORT

- A. The Contractor shall be required to prepare and submit for review and approval the following:
 - 1. Factory Acceptance Test Plan and procedures.
 - 2. Site Acceptance Test Plan and procedures.
 - 3. Test Schedules.

4. Test Reports.
5. Instrument and (applicable) component calibration sheets.

3.2 FACTORY TESTING

- A. Factory Acceptance Test (FAT) and verification for all deliverable equipment, programs, and associated documentation shall be performed prior to shipment of the system. The tests shall verify that the equipment is manufactured and assembled correctly, is operating as designed, and is in compliance with the contractual requirements. The tests shall verify that the software and hardware meet the functional and performance requirements of the project. The FAT shall be performed at the Contractor's factory and shall be witnessed by Owner personnel.
- B. Testing requirements shall be part of every PLC installation. The Contractor shall demonstrate the system was fully tested during development and installation.

3.3 INSTALLATION

- A. Mount and shim to precise alignment floor mounted control panels so doors operate without binding. Provide sealant for conduit entering the panels.
 1. Anchor panels in a manner to prevent the enclosure from racking, which may cause the access doors to become misaligned.
 2. Provide sunshields where shown on the Drawings.
- B. Floor-mounted panels except in dry control rooms or electrical equipment rooms shall be mounted on 3-1/2-inch minimum height concrete pads or grouted bases as specified. Coating shall be provided for outdoor panels in contact on concrete. Field panels and cabinets shall be mounted in compliance with 26 27 16
- C. Spray terminals and terminal blocks after all terminations have been completed with a silicone resin similar to Dow Corning R-4-3117 conformal coating. Spray coating only required for control panels in corrosive or classified installation environments.
- D. Provide panels with the Record As-built schematic, connection, and interconnection diagrams mounted behind Plexiglas holder on the inside of the door. Place documentation in a water proof clear bag in the panel document holder.
- E. Vacuum clean control panels and cabinets.

3.4 SITE ACCEPTANCE TESTING

- A. PROCEDURES: Section 40 61 21

- B. The following testing is in addition to Section 40 61 21 requirements for the preoperational test phase and component test phase.
- C. A System Acceptance Test (SAT) and a System Operational Acceptance Test (OAT) shall be performed at the site. The final documentation will then be reviewed for completeness. Site Acceptance Testing shall be witnessed by SPU personnel.
- D. The SAT shall include the requirements as follows:
 - 1. The acceptance test shall verify that the equipment and all cables have been properly installed, have not been damaged, and have not failed in shipment or storage
 - 2. The acceptance test shall demonstrate stable operation of all PLC I/O modules, wiring, and data transmission to the OIU under actual operating or simulated conditions. The test shall also demonstrate proper operation of all digital or sequential control. All start/stop, open/close, raise/lower and similar commands and all discrete status inputs shall be tested for proper operation. In addition, all alarms, both analog and discrete, shall be tested.
 - 3. After one week of operation without notable events or failures, finalize the wiring between the new PLC and the I/O. Organize unused wiring to provide a neat and clean appearance.
- E. The System OAT shall require the testing of system functions, software, and performance in hand-only mode after completion of all site installation tests. These tests shall verify complete operation of the system or site, including additional tests required to verify field-installed equipment, which was not available at the factory. The Contractor shall be required to perform the following:
 - 1. Verify the facility installation.
 - 2. Verify the SAT.
 - 3. Verify operation of any local operator interface device.

END OF SECTION

SECTION 40 67 33

PANEL WIRING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Installation
 - 6. Testing

1.2 SCOPE

- A. This section specifies wiring requirements for wiring of process control panels.
- B. Comply with the specified products in Sections 40 61 13 and 40 67 19. Panels that do not comply with the specified products and specified logic method, hardwired or PLC logic, shall not be accepted. Cost to retrofit the panel as specified shall be borne by the panel supplier. Corrections or modifications to UL 508A Industrial Control Panels shall be transported to the panel supplier's facility for corrections, testing, relabeling and inspection.
- C. All panel wiring is to be completed within a UL 508A certified fabrication facility. Field modifications require a UL inspector site inspection for approval of panel corrections and to re-label the panel after the field modifications are completed.
- D. Submittals as specified in Section 01 33 00 and Section 40 61 13.

1.3 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty workmanship for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.
- C. REFERENCE STANDARDS:
 - 1. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein.

In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued,

Reference	Title
NEMA 250	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

D. LISTED PRODUCTS

1. Equipment and components to be Underwriters Laboratory (UL) listed for the purpose per Section 40 61 13 or UL recognized.
2. Provide factory applied UL 508A labels for control panels. Where intrinsic safety barriers are used within a control panel, provide UL 698A factory applied label as required by UL.

1.4 SUBMITTALS

A. PROCEDURES: Section 01 33 00 and 40 61 13

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Submittal items required include:
1. Wire Types
 2. Labeling materials and methods
 3. Wiring lugs
 4. Wireways
 5. Hinge wiring method description

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.1 INTERNAL PANEL WIRING

- A. Panel control wiring: Single conductor stranded copper NFPA No. 70 Type MTW No. 16 AWG minimum, with an exception for factory supplied PLC wiring harnesses that are U.L. approved.
- B. Panel instrument wiring: Twisted No. 18 AWG shielded pair or tri conductors.
- C. Panel power wiring: Conductors specified in Division 26 and meet the NFPA No. 70 NEC requirements for power including phase, grounded, and grounding conductors.
- D. Arrange wiring neatly, cut to proper length, and remove surplus wire.
- E. No more than two connections made to one terminal.

- F. Wiring shall be supported independently of terminations by lacing to panel support structure or by slotted flame-retardant plastic wiring channels.
- G. Power and control wiring carried in covered channels separate from low voltage signal circuits.
 - 1. Wiring channel fill not to exceed 40 percent per NFPA 70.
- H. Restrain by plastic ties or ducts or metal raceways.
- I. Provide abrasion protection for wire bundles that pass-through holes or across edges of sheet metal.
- J. Hinge Wiring: Secure at each end so bending or twisting will be around longitudinal axis of wire. Protect bend area with sleeve.
- K. Connections to Screw Type Terminals:
 - 1. Locking-fork-tongue or ring-tongue lugs.
 - 2. Use manufacturer's recommended tool with required sized anvil to make crimp lug terminations.
 - 3. Splicing and tapping of wires, allowed only at device terminals or terminal blocks.
 - 4. Wires terminated in a crimp lug, maximum of one.
 - 5. Lugs installed on a screw terminal, maximum of two.
- L. Connections to Compression Clamp Type Terminals:
 - 1. Strip, prepare, and install wires in accordance with terminal manufacturer's recommendations.
 - 2. Wires installed in a compression screw and clamp, maximum of one for field wires entering enclosure, otherwise maximum of two.
- M. Harness Wiring:
 - 1. 120V ac: No. 14 AWG, MTW.
 - 2. 24V dc: No. 16 AWG, MTW where individual conductors are used and Type TC shielded tray cable where shielded wire is used.
- N. Plastic Wire Ducts Color:
 - 1. 120V ac: White.

2. 24V dc: Gray.
 3. Communications Cables and Fiber Optic Jumpers: Orange.
- O. Provide a minimum of 1-1/2 inches between plastic wire ducts and terminal blocks.
- P. Control Relay Arrangement: Install control relays associated with specific loops in same panel section as corresponding terminal blocks or side panels. Provide 20 percent space for future relays. Locate spare space in same sections as spare terminal blocks.
- Q. CONDUCTOR IDENTIFICATION:
1. Wiring colors per NFPA 79.
 2. Wire tag numbers to indicate to/from termination points and the associated equipment.
 3. Wire tag numbers to be machine printed on white sleeves with text 1/8 inches high minimum in permanent black ink.
- R. FIELD WIRING:
1. Field wiring shall be connected to separate dedicated terminal blocks in a dedicated part of the panel where the field cables enter the panel.
- S. PANEL GROUNDING
1. Provide each control panel with two copper ground bars.
 - a. Bond one bar (NEC required) to the panel or panel frame or back-plate and to the facility grounding system.
 - b. Mount on insulated stand-offs second (signal) ground bar and bond to the panel ground bar only at one point.
 - 1) Bond signal circuits, signal cable shields, and low-voltage DC power supply commons to the signal ground bar.
 - 2) Ground field analog wiring shields at the signal ground bar. Test to verify that single ground point at panel signal ground bar.
 2. Bond surge protectors and separately derived AC power supplies to the frame ground bar.
 3. Panels exceeding 36-inches width shall contain ground bars shall be 1/4- by 1-inch copper bars extending the entire length of the panel interior at the bottom of the panel.

3.2 TESTING

A. FACTORY TESTING:

1. Prior to shipment, the manufacturer tests the functional operation of the control panels as described in Section 40 61 21.
2. Complete point to point testing and verification of each wire.
3. The Owner requires the factory test to be a witnessed test. The Contractor shall include in the bid price the expense for travel and accommodations for one (1) representative from the Owner to witness the factory test at the manufacturer's facility. If test results require the testing to be redone, the additional costs for additional testing shall be borne by the Contractor.

B. SHIPMENT, PROTECTION AND STORAGE:

1. Equipment shipment, protection and storage shall conform to the requirements specified in Section 01 66 00

END OF SECTION

SECTION 40 71 13

MAGNETIC FLOW METERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Product Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of the Magnetic Flow Meters measuring system(s). This includes testing, documenting, and start up.
- B. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. UL – Underwriters Laboratory approved
- B. ASTM – American Society for Testing and Materials
- C. NEMA – National Electrical Manufacturer's Association
- D. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

C. Product Data: For each type of device and system:

1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided.
 - 1) Must include:
 - a) Dimensional Drawings
 - b) Materials of Construction
 - (1) Sensor
 - (2) Liner

- (3) Electrodes
- (4) Process Connection

- 2) Accuracy
- 3) Range
- 4) Enclosure Rating
- 5) Classification Rating
- 6) Power Requirements
- 7) Output Options

- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.
- C. This section specifies requirements for supply and installation of Magnetic Flow Meters listed in Section 40 06 70 Schedules of Instrumentation for Process Systems.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Flow Meter candidate manufacturers and models:
 - 1. Endress+Hauser Promag W500 – Full Pipe Flow Meters
 - 2. Approved equal by Project Engineer
 - 3. To conform to specified requirements, the manufacturer's standard product may require modification.

2.2 GENERAL

- A. Magnetic flow meter provided as a system consisting of a flow tube with locally or remotely mounted converter / indicating transmitter as listed in the instrument

schedule or as shown on the drawings. Meters to be provided with all required interconnecting cables between flow tube and transmitter.

- B. Transmitter specified is to comply with Section 40 61 13 transmitter requirements.

2.3 FLOW METERS

- A. Flow Tube:

1. The flow meter shall be microprocessor based and possess a method in which to store the sensor calibration and transmitter setup information in non-volatile memory. The electronics shall be interchangeable for meters sizes 1" – 120"
2. The sensor shall consist of a stainless-steel flow tube with ANSI B16.5 or AWWA C207 carbon steel or stainless-steel flanges. The flanges shall carry Class 150 or 300 for 24" and smaller, and AWWA Class D for 28" and larger as specified.
3. The sensor tube shall be lined with hard rubber.
4. The sensor shall house two measuring electrodes, a grounding electrode, and one for physical empty pipe detection. The electrodes shall be made of 316L SS.
5. The full-bore magnetic flowmeter in sizes 1"-120" shall maintain zero pressure loss while achieving 0.5% of rate accuracy even when mounted directly before or after a piping elbow, T-fitting or insertion device. This flow tube shall have four measuring electrodes (sizes 1-2.5") and six measuring electrodes (sizes 3"-120") plus a grounding electrode and an empty pipe electrode.
6. The external sensor housing shall enclose the coil assemblies and internal wiring. The materials shall be designed and constructed to prevent moisture ingress and promote corrosion resistance.
7. Process Connection: Flange, ANSI B16.5, Class 150, raised face.
8. Flow tubes shall be pressure rated from full vacuum to 300 psig, unless otherwise noted.
9. Flow tube sizes below 2 inches may be wafer-style ductile-iron or full-body flanged construction.
10. Grounding Ring required and must be provided with flow meter.
11. The sensor shall be rated for NEMA 6P/IP68 service and shall allow for permanent immersion in water depths up to 10 feet.
12. Materials:

- a. Flow Tube: Stainless steel.
- b. Flange: Stainless steel
- c. Electrodes: 316 L stainless steel
- d. Grounding Rings: Same metal as for the electrodes
- e. Liner: Hard rubber

B. Indicating Transmitter:

1. The transmitter shall be a three-stage microprocessor controller mounted locally on or near flow tube as specified in the instrument schedule. The transmitter shall operate on AC (100 to 240V) or DC (24 V) via a dedicated or universal power supply as specified. The transmitter housing will carry a NEMA 4X rating and shall be constructed to prevent moisture ingress, promote corrosion resistance, and be impervious to saline environments.
2. The transmitter display shall indicate simultaneous flow rate and total flow and user-selectable engineering units, readout of diagnostic remedy messages.
3. 4-20 MA output proportioned to flow range.
4. The transmitter shall internally retain all setup parameters, calibration parameters and accumulated measurements in non-volatile memory in the event of power failure.
5. Pules output selectable settable for volumetric flow total from 1 to 500 gallons per pulse.
6. Hazardous Approval for installation is non-hazardous areas.
 - a. FM &CSA approved
7. Internal circuitry to drive flow signal to zero upon flow meter determined empty pipe condition.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13
- B. Install all components of Magnetic Flow Meters system in accordance with manufacturer's specifications and instructions for the specified functional requirements.

- C. Ensure proper installation of the Magnetic Flow Meters system so as to not result in false reading due to ambient conditions or equipment at the installation site.
- D. Comply with mounting details provided on the drawings.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Instruments shall be calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26
- B. CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day to evaluate the installation of the instruments, testing and calibration, certification of proper installation, and training.

END OF SECTION

SECTION 40 72 13

ULTRASONIC LEVEL METERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Product Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of the Ultrasonic level measuring system(s). This includes testing, documenting, and start up.
- B. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. UL – Underwriters Laboratory approved
- B. ASTM – American Society for Testing and Materials
- C. NEMA – National Electrical Manufacturer's Association
- D. NEC – National Electrical Code
- E. NFPA No. 70, NEC - National Electrical Code
- F. NFPA No. 79, Electrical Standard for Industrial Machinery.
- G. ISA – Instrumentation, Systems, and Automation Society.

- H. ICS-1 – General Standards for Industrial Control and System
- I. ICS-2 – Standards for Industrial Control Devices, Controllers and
- J. ICS-3 – Industrial Systems.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:

1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Ultrasonic Level Measurement System candidate manufactures and models:
 1. Siemens, SITRANS Probe LU.
 2. Approved equal by Project Engineer.

2.2 GENERAL

- A. Ultrasonic Level Measurement provided as a system consisting of a 2-wire loop powered ultrasonic transmitter with a remotely mounted LCD display and an optionally mounted remote HART display LCD display, unless otherwise noted. Units to be provided with all required interconnecting cables.
- B. Transmitter specified is to comply with Section 40 61 13 transmitter requirements.

2.3 FEATURES

- A. Process Connection shall be an FMS 200 mounting bracket connection.
- B. The transmitter shall have a multi-field backlit LCD display with individual alarm status lights and meet the following requirements:
 1. Calibration and programming of the transmitter shall be via an intrinsically safe infrared receiver handheld programmer.
 2. The resolution shall be 0.1% of program range or 3mm, whichever is greater.

3. Auto False-Echo Suppression to avoid false echoes from fixed obstructions.
 4. Mount transmitter as shown on the drawings.
- C. The transducer operating principle shall be based on acoustic impulses emitted from an Ultrasonic transducer reflecting back from the material surface. The transit time of pulse travel from generation to echo is measured. The elapsed time is proportional to the distance between the transducer face and material surface.
- The primary sensor shall be an ultrasonic transducer containing a Buna-N seat with ETFE or PVDF and shall meet the following requirements:
1. The transducer housings shall be PBT, or equal.
 2. The Accuracy shall be +/- 0.15% of range or 6mm; whichever is greater.
- D. The Ultrasonic Level Measurement System shall be certified in the following:
1. General Purpose; CSA, FM, CE, RCM.
 2. CSA/FM, Class 1, Div. 1. Groups A, B, C, D; Class 2, Div. 1, Groups E, F, G; Class III T4.
 3. Type 4X/NEMA 4X, Type 6/NEMA 6/IP67/IP68.

2.4 ELECTRICAL REQUIREMENTS

- A. Transmitter and transducer for the Ultrasonic level measurement system shall meet/provide following standards/requirements:
1. The transmitter power supply shall be 24 VDC nominally with 550 ohms and a maximum voltage of 30 VDC. Transducer power shall loop powered.
 2. Ambient operating temperature of -40F to 175F.
 3. Transmitter: 4 to 20 mA dc output signal.
 - a. Outputs shall be scalable and assignable to measure distance to product being level, volume and flow monitoring of liquids in open channels, storage vessels, and simple process vessels.
 4. Transducer to be FM approved for Class I & II, Div. 1 Groups A, B, C & D; Class II, Div. 1, Groups E, F, & G.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13.
- B. Install all components of Ultrasonic level measuring system in accordance with manufacturer's specifications and instructions for the specified functional requirements.
- C. Ensure proper installation of the Ultrasonic level measuring system so as to not result in false reading due to ambient conditions or equipment at the installation site.
- D. Comply with mounting details provided on the drawings.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Instruments shall be calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26
- B. CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day to evaluate the installation of the instruments, testing and calibration, certification of proper installation, and training.

END OF SECTION

SECTION 40 72 43

PRESSURE TYPE LEVEL TRANSDUCERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Products Requirements
 - 7. Installation
 - 8. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of Pressure Type level measuring system(s). This includes testing, documenting, and start up.
- B. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. UL – Underwriters Laboratory approved
- B. ASTM – American Society for Testing and Materials
- C. NEMA – National Electrical Manufacturer’s Association
- D. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00 and 40 61 13.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Pressure Transmitter candidate manufacturers and models:
 - 1. Druck, model PTX 1830,
 - 2. Endress + Hauser, FMX21 series,
 - 3. TE Connectivity KPSI 735 series,
 - 4. Approved equal by Project Engineer.
 - 5. To conform to specified requirements, the manufacturer's standard product may require modification.

2.2 GENERAL

- A. Level shall be sensed and transmitted by a submersible type pressure transmitter. Level measurement provided as a system consisting of a pressure transmitter, sensor termination enclosure with desiccant and waterproof vent, integral cable, hanger and weight.
- B. Transmitter specified is to comply with Section 40 61 13 transmitter requirements.
- C. The Contractor shall supply weights as necessary to ensure that the pressure transducer will hang straight down the well and not float in the well water column.
- D. The unit shall be purchased with sufficient length to set the transmitter at 1 foot above the pump as indicated on the Drawings and extend to the junction box as shown on the Plans, with a spare 10 feet of cable.

2.3 FEATURES

- A. Process Connection: Sealed/Submersible in media.
- B. System error shall not exceed $\pm 0.25\%$ of level range
- C. Combined non-linearity, hysteresis, and repeatability accuracy of 0.1% of full scale.

- D. Temperature Range: -20 to 60 °C (Operating), 0 to 50°C (Compensated).
- E. Environmental Ratings:
 - 1. Transmitter and cable: IP 68, NEMA 6P.
 - 2. Junction Box: IP 66, NEMA 4.
- F. Transmitter Materials:
 - 1. Body: Welded 316 stainless steel.
 - 2. Cable: FMK Polyurethane or ETFE.
- G. Cable Hanger Materials: 304 stainless steel.
- H. Weight Materials: Stainless steel, brass, or other material that will not corrode, and will not contaminate the water supply well. Lead weights are not acceptable.
- I. Transmitter to be FM approved for Class I & II, Div. 1 Groups A, B, C & D.
- J. Transmitter shall be supplied with a sensor termination enclosure with desiccant and waterproof vent. Sensor and termination enclosure shall be of same manufacturer and intended for use with each other.

2.4 ELECTRICAL REQUIREMENTS

- A. Input current: 20 mA max (loop Power)
- B. Signal Output: 4-20mA, 0-5 VDC, 0-2.5VDC Analog signal. Signal shall change in direct linear proportional to changes in measured level.
- C. Insulation resistance: 100 Mega Ω @ 500 VDC Capable of withstanding a 600 Volt spike in accordance with ENV 50142 without damage.
- D. Circuit protection: polarity, surge/ shorted output.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13
- B. Install all instruments and components of level measuring system in accordance with manufacturer's specifications and instructions for the specified functional requirements.

- C. Comply with mounting details provided on the drawings and or recommendations of the manufacturer.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Instruments shall be calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.

END OF SECTION

SECTION 40 73 13

PRESSURE GAUGES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Products Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of Gauge Pressure and measuring system(s). This includes testing, documenting, and start up.
- B. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer's Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ICS-1 – General Standards for Industrial Control and System
- G. ICS-2 – Standards for Industrial Control Devices, Controllers and

- H. ICS-3 – Industrial Systems.
- I. UL – Underwriter’s Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions.
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 - 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:

1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided.
- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: As specified herein and on the drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Simple Pressure Gauge Manufacturers:
 1. Marsh Instrument Company.
 2. Ashcroft Industrial Instruments (Dresser).
 3. Foxboro/Jordan, Inc.
 4. Marshalltown Instruments, Inc.
 5. U.S. Gauge Div. Of Amtek.
 6. Approved equal by Project Engineer.
 7. To conform to specified requirements, the manufacturer's standard product may require modification.
- B. Snubber Manufacturers:
 1. Cajon Company.
 2. Weksler Instruments, Corp.
 3. Approved equal by Project Engineer.
 4. To conform to specified requirements, the manufacturer's standard product may require modification.

- C. Diaphragm Seal A. (For chlorine and sulfur dioxide under pressure)
 - 1. WIKA.
 - 2. ASHCROFT.
 - 3. Approved equal by Project Engineer.
 - 4. To conform to specified requirements, the manufacturer's standard product may require modification.

- D. Diaphragm Seal B. (Chemical Solutions, where breakage does not cause a major shutdown)
 - 1. Plast-O-Matic Valves, Inc.
 - 2. Harrington Ind. Plastics, Inc.
 - 3. Utilities Supply.
 - 4. Approved equal by Project Engineer.
 - 5. To conform to specified requirements, the manufacturer's standard product may require modification.

- E. Annular Seal (For sewage, sludge, liquids containing solids, and pulsating flow)
 - 1. Red Valve Company, Inc.
 - 2. Ronnington-Petter.
 - 3. Approved equal by Project Engineer.
 - 4. To conform to specified requirements, the manufacturer's standard product may require modification.

2.2 GENERAL

- A. Pressure gauges shall be provided on discharge connections to pumps where specified on the plans; on discharge connections from blowers and compressors; each side of pressure reducing valves; and where shown. In all locations (such as certain pump suction connections) where pressure may vary from below to above atmospheric head, compound gauges shall be installed.

- B. Gauges attached to systems involving chemicals solutions, corrosive fluids, or non-solid containing fluids shall be equipped with diaphragm seals, or equal protective pressure sensing devices.

- C. Provide all parts, materials, fluids, etc. necessary for maintenance and calibration purposes throughout the warranty period. Deliver all of these supplies before project substantial completion.

2.3 FEATURES

- A. The gauge shall have a 3-1/2-inch dial, 1/4-inch threaded, a snubber adapter, and a shutoff valve.
- B. Gauges shall be calibrated to read in applicable units, with an accuracy of +/- 1 percent, to 150 percent of the working pressure of pipe or vessel to which they are connected.
- C. Diaphragm Seals shall be rated at 200 PSI with 1/2-inch inlet, and a 1/4-inch outlet and be liquid filled.
- D. Pressure shall be sensed by a flexible sleeve and transmitted to the gauge through a captive fluid. The sleeve shall be fabricated so as to isolate the body from the process liquid.
- E. Process Connection: As specified herein and as shown on the drawings.
- F. Gauge Materials:
 - 1. Body: Welded 316 stainless steel.
 - 2. Snubber Adapter: 316L stainless steel.
- G. Diaphragm Seal A:
 - 1. Seals: Hastelloy C-276.
- H. Diaphragm Seal B:
 - 1. Body: PVC.
 - 2. Nuts and Bolts: 316 stainless steel.
 - 3. Pressure Diaphragm: Teflon.
 - 4. Vacuum Service Diaphragm: Elastomer.
- I. Annular Seal:
 - 1. Body: Flanged stainless-steel spool or Wafer
 - 2. Sensing Sleeve: Buna N.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 21.
- B. All gauges shall be installed with the face in the vertical position, at the location shown in the Contract Documents, and in strict accordance with the manufacturer's printed instructions. Care shall be taken to minimize the effect of water hammer or vibrations on the gauges. In extreme cases, the gauges may have to be mounted independently, with flexible connectors.
- C. Install all components of pressure measuring system in accordance with manufacturer's specifications and instructions for the specified functional requirements.
- D. Comply with mounting details provided on the drawings.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Instruments shall be calibrated and tested on site in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 21.
- B. The CONTRACTOR shall furnish and install pressure gauges as specified, complete, including all fittings, snubbers, connections, gaskets, supports, and accessories in the locations shown or specified, in accordance with the requirements of the Contract Documents.
- C. CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day to evaluate the installation of the instruments, testing and calibration, certification of proper installation, and training.

END OF SECTION

SECTION 40 75 05

MULTI-PARAMETER ANALYZER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Product Requirements
 - 6. Installation
 - 7. Testing
 - 8. Manufacturer's Services

1.2 SCOPE

- A. This Section specifies requirements for supply and installation a modular single or dual channel controller that works with analog sensor modules and/or digital sensors. It includes testing, documenting, and start up.
- B. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- C. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. UL/CSA 61010-1
- B. ASTM – American Society for Testing and Materials
- C. NEMA – National Electrical Manufacturer's Association
- D. NEC – National Electrical Code

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions.
- B. Certifications
 - 1. Tests and approvals: CE, MET (corresponding to UL according to IEC 61010)

2. Wall Mounted: IP67 (NEMA 4X); Enclosure Mounted: IP54 for control cabinet door
- C. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00 - Submittal Procedures
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions, including mounting requirements.

- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Multi-Parameter Analyzer System candidate manufactures and models:
 - 1. ProMinent Fluid Controls, Inc.
 - a. DULCOMETER DACb2_Ir
 - 2. Approved equal

2.2 PROMINENT: DULCOMETER DACB2_LR

A. GENERAL

- 1. The Multi-Parameter Analyzer controller shall consist of a system of microprocessor-based DULCOMETER DACb2_Ir controller, IP67 certified housing, and large HMI screen to display measured value trends that shall be wall mounted or optionally be cabinet mounted. The system will be used as shown in the drawings.
- 2. The controller will have the ability to connect to various analyzers/sensors that measure various process variables in the following ways
 - a. mV connection type
 - 1) pH 0.00 – 14.00
 - 2) ORP voltage: -1,500 mV – +1,500 mV
 - b. mA connection type (Amperometric measured variables)
 - 1) Chlorine
 - 2) Chlorine dioxide
 - 3) Chlorite

- 4) Bromine
- 5) Ozone
- 6) Hydrogen peroxide
- 7) Peracetic Acid
- c. mA connection type (potentiometer measured variables)
 - 1) pH
 - 2) ORP voltage
 - 3) Fluoride
- d. Conductivity
 - 1) Via Transmitter 0/4 – 20 mA
- e. Temperature
 - 1) Via Pt 100/Pt 1000, measuring range 0 – 302 degrees Fahrenheit

B. FEATURES

1. Tests and Approvals
 - a. CE, MET (Corresponding to UL according to IEC 61010)
 - b. Wall mounted: IP 67 (NEMA 4X); Cabinet mounted: IP 54
2. The controller is available with the following power requirements:
 - a. AC powered: 90-253 Vac, 50/60 Hz, 25 VA
 - b. 24 VDC
3. The controller will have the following forms of communication
 - a. LAN/ Ethernet
 - b. Profibus-DP
 - c. Modbus RTU
4. The controller has one, two, or three channels for the continuous measurement and control of process variables

5. The controller has 2-way PID control
 6. The controller is equipped with a data logger that can output to a storage.
 7. The controller will have the following resolution in its measurements
 - a. pH: 0.01
 - b. ORP Voltage: 1 mV
 - c. Temperature: 32 degrees Fahrenheit
 - d. Amperometric analysis (chlorine etc.): 0.001/0.01 ppm, 0.01 vol. %, 0.1 vol %
 8. The controller will have an accuracy of 0.3% based on the full-scale reading
 9. The controller will have a measurement input: pH/ORP (input resistance > 0.5 x 10¹² ohms)
 10. The controller will have temperature compensation for pH, conductivity, and fluoride and pH compensation for Free Chlorine.
 11. There will be 7 remote control input for the functions pause control / sample water fault, parameter set switch-over, level monitoring of chemical tanks
 12. The controller's outputs will have the following characteristics
 - a. There will be 3, 4-20 mA electrically isolated, max. load 450 ohms, range and assignment (measured, correction, control variable) can be set
 - b. There will be 4 x 2 pulse frequency outputs for metering pump control, 2 relays (limit value, 3-point step or pulse length control)
 13. There will be two powered relays at 250 V ~3 A, 700 VA contract type changeover contact
 14. The controller will function in an ambient temperature range of 0 – 122 degrees Fahrenheit
- C. COMPONENTS
1. Dimensions:
 - a. DACb2_lr controller (9.84x8.66x4.80 in.)
 2. Weight:

- a. DACb2_lr controller (3 lbs.)

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install all components of chlorine monitoring system in accordance with manufactures specifications and instructions.
- C. Instruments shall be installed, calibrated and tested on site in accordance with the requirements of Section 40 61 21 and 40 61 26 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer. CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day got the installation of the instruments and for certification of proper installation.
- D. CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day for the calibration and testing of the instruments after certification of proper installation.
- E. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed well system.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation of the analyzer system so as to not be result in false reading due to ambient conditions or equipment at the installation site.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26
- B. The contractor shall provide for a manufacturer's representative to be onsite for 1 day during start-up for the start-up and calibration of the analyzer system.

END OF SECTION

SECTION 40 75 21
CHLORINE ANALYZERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Product Requirements
 - 6. Installation
 - 7. Testing
 - 8. Manufacturer's Services

1.2 SCOPE

- A. The Chlorine Measurement Device shall be based on an amperometric type Chlorine sensor, providing continuous measurement of residual chlorine without the use of any reagents or buffers in the sample stream. A membrane shall protect the electrodes from flow, pressure, and conductivity-based interferences.
- B. The Chlorine Measurement Device(s) shall be the standard equipment of the supplier involved in the manufacture of similar type equipment and shall be as manufactured by ProMinent Fluid Controls, Inc. or Engineer Approved Equal.
- C. CONTRACTOR shall provide all components, piping, wiring, accessories and labor required for a complete, workable and integrated system.
- D. Instruments shall be mounted as shown on the plans. All metal mounting hardware shall be stainless steel.

1.3 REFERENCE STANDARDS

- A. American National Standard Institute (ANSI)
- B. Occupational Safety and Health Administration (OSHA)
- C. National Electrical Manufacturers Association (NEMA)
- D. National Electrical Code (NEC)

- E. NSF International

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions.
- B. The Chlorine Measurement Device shall be the product of a manufacturer that has designed and manufactured similar equipment. The manufacturer must have ISO 9001 and UL 508A Certification.
- C. Before shipment, the manufacturer shall inspect the equipment for quality of construction verifying all fasteners and fittings are tight, all wires are secure, and connections are whisker-free. The manufacturer shall repair any equipment not conforming to the requirements outlined herein and shall conduct a follow-up test to confirm compliance.
- D. Under this specification section, all equipment provided is to be from a single supplier or manufacturer that shall assume full responsibility for the completeness and proper installation of the Chlorine Measurement Device.
- E. The manufacturer, to ensure quality and unit responsibility, must assemble and test the Chlorine Measurement Device at its facility. The Chlorine Measurement Device shall be a standard regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff and fabricating personnel to complete the work specified.
- F. The manufacturer shall warranty the above specified equipment for 12 months from equipment start-up or 24 months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00 - Submittal Procedures
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 - 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.

2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
- C. Product Data: For each type of device and system:
 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions, including mounting requirements.
- E. Operation and maintenance information.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: Section 40 06 30 instrument schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Free Chlorine sensor candidate manufactures and models:
 1. ProMinent DULCOTEST CLE 3.1 – mA – 2 ppm (Part # 1018369)
 2. Approved equal

2.2 GENERAL

- A. The chlorine sensor shall be an amperometric type, measuring free chlorine (hypochlorous acid HOCl) where there is a high rate of combined chlorine and/or in the case of pH values up to 8.5 (with D1C pH correction) providing continuous measurement of residual chlorine without the use of any reagents or buffers in the sample stream. A membrane shall protect the electrodes from flow, pressure, and conductivity-based interferences.
- B. The vendor shall supply all components necessary for a functional system including but not limited to the sensor(s), sensor holder, and all required cables and spare parts. The sensor, and holder, shall all be made by the same manufacturer to ensure compatibility and provide sole source responsibility.

2.3 FEATURES

- A. The measured value shall be either free chlorine or total chlorine as specified in 2.02 above. Specific sensor model selection shall be per the best recommendation of the analyzer manufacturer or their Authorized Manufacturer's Representative. Selection shall be made to best meet the application requirements.
- B. Signal response time to 90% of measured value shall be better than two minutes. Drift shall be less than 2% per month.
- C. The sensor shall include integral automatic temperature compensation with a temperature range of 41 – 113 degrees Fahrenheit. The signal to the monitor shall be 4-20mA via 2-wire technology. The sensor shall feature a terminal block with watertight cable gland for field connection of any length cable to the monitor.
- D. For applications calling for Free Chlorine measurement, automatic pH compensation shall be provided employing a double junction pH sensor with a signal converter to provide 4-20mA signal to the monitor via 2-wire technology.
- E. The sensor shall have a measurement range of 0.01 – 5.00 mg/l
- F. The sensor shall have a pH range of 5.5 – 8.0 (with up to 8.5 with D1C pH correction)
- G. The sensor shall have maximum operating pressure of 14.5 psi (1 bar)
- H. The sensor shall have a maximum operating inflow of 7.9 – 14.9 gph (30 – 60 l/h) in the DGM or DLG III
- I. The sensor shall operate on 16 – 24 VDC (two wire technology)
- J. The sensor shall have a 4 – 20 mA uncalibrated output signal for its measurement range.

2.4 SENSOR HOLDER

- A. The sensor holder shall be transparent PVC material with integral flow control valve and rotameter for setting the sample flow rate between 8 and 15 gph. The flow shall be directed at the sensor membrane to provide a continuous cleaning action. Mounting brackets for wall mounting shall be included.
- B. A flow switch shall be provided as part of the rotameter. This switch shall be wired to the controller that shall be able to initiate a pause to chemical feed if a loss of sample flow is detected.
- C. The sample flow shall be controlled via a control valve, pressure regulator and installed a pressure gauge.

2.5 DIMENSIONS

- A. The sensor shall be 221 mm long with a diameter of 25 mm unless otherwise noted.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. The analyzer, sensor, and sensor holder specified herein shall be installed on a single back panel and shall be fully wired and ready for installation with sample tubing or piping connections as specified by the customer. The analyzer back panel shall be made of Polyethylene/Polypropylene sheet material of at least 3/8" thickness and shall be UV resistant.
- C. Install all components of chlorine sensor in accordance with the manufacturer's specifications and instructions.
 - 1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
 - 2. The Contractor shall install the specified equipment per the contract documents and manufacturer's recommendations.
 - 3. The Contractor shall obtain and provide a manufacturer's certificate showing the satisfactory calibration and testing of the equipment.

4. An authorized manufacturer's representative shall inspect the installation of all work furnished under this section and shall provide a certificate of proper installation.
- D. Instruments shall be installed, calibrated and tested on site in accordance with the requirements of Section 40 61 21 and 40 61 26 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- E. CONTRACTOR shall provide the services of the manufacturer's representative for a minimum of one day for the calibration and testing of the instruments after certification of proper installation.
- F. In addition, the instruments shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed well system.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation of the chlorine analyzer transmitter so as to not be result in false reading due to ambient conditions or equipment at the installation site.

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26
- B. Services of an experienced, Authorized Representative who shall be present at the job site or classroom designated by the City/District for the minimum person-days listed for the services shown below
- C. One person-day per site for inspection, start-up, functional testing and certificate of proper installation
- D. One person-day per site for training and commissioning
- E. All services shall be inclusive of travel and associated expenses

END OF SECTION

SECTION 40 78 16

INDICATING LIGHTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Product Requirements
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of indicating lights

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer’s Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ISA – Instrumentation, Systems, and Automation Society.
- G. ICS-1 – General Standards for Industrial Control and System
- H. ICS-2 – Standards for Industrial Control Devices, Controllers and
- I. ICS-3 – Industrial Systems.
- J. UL – Underwriter’s Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)
 - 1. Standard 508 (Industrial Control Panels for General Use).

2. Standard 698 (Industrial Control Panels Relating to Hazardous (Classified) Locations)
3. Standard 913 (Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations)

K. NETA – National Electrical Testing Association.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 67 16 and 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.5 SUBMITTALS

- A. Submittal requirements specified in: Section 01 33 00.
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements,

with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions.
- E. Operation and Maintenance Manual if applicable.

PART 2 PRODUCTS

2.1 GENERAL

- A. Pilot Devices shall be provided as a Panel Assembly component where indicated, specified, or required to perform the functional requirements of the System, as specified. All Pilot Devices shall meet the following minimum specifications, unless otherwise noted.
 - 1. All pilot devices shall be of heavy-duty, metallic, type 4/13, watertight/oiltight construction. Units shall mount through a 30.5 mm round hole.
 - 2. All pilot devices shall have custom legends as shown. Legends shall be black with white letters, and letter height shall be minimum 3/16-inch-high characters.
 - 3. All button and lens colors shall be as shown. Color code is as follows:
 - 4. A = Amber, B = Blue, G = Green, R = Red, Y = Yellow, W = White
 - 5. All pilot devices shall be equipped with a sufficient number of contact blocks to accomplish the switching functions specified.
- B. Indicating lights shall meet the following minimum specifications, unless otherwise noted.
 - 1. All indicating lights shall be full voltage type with LED lamps. Units shall be rated for the voltage shown.
 - 2. All indicating lights shall be "push-to-test" type.
 - 3. All indicating light lenses shall be plastic.

C. Candidate manufacturers and models include the following

1. Allen-Bradley, Bulletin 800T.
2. Square D. Co., Type T.A
3. Approved Equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install per manufacturer's instructions.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation per manufacturers recommendations

3.3 MANUFACTURER'S SERVICES

- A. REQUIREMENTS: Section 40 61 13 and 40 61 26

END OF SECTION

SECTION 40 78 19
SWITCHES AND PUSH BUTTONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Product Requirements
 - 6. Installation
 - 7. Testing

1.2 SCOPE

- A. This Section specifies requirements for supply and installation of push buttons and indicating lights

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer’s Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ISA – Instrumentation, Systems, and Automation Society.
- G. ICS-1 – General Standards for Industrial Control and System
- H. ICS-2 – Standards for Industrial Control Devices, Controllers and
- I. ICS-3 – Industrial Systems.
- J. UL – Underwriter’s Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)

1. Standard 508 (Industrial Control Panels for General Use).
 2. Standard 698 (Industrial Control Panels Relating to Hazardous (Classified) Locations)
 3. Standard 913 (Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations)
- K. NETA – National Electrical Testing Association.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.

- C. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Candidate manufacturers and models include the following

1. Allen-Bradley, Bulletin 800T.
2. Square D. Co., Type T.A
3. Approved Equal

2.2 GENERAL

- A. Pilot Devices shall be provided as a Panel Assembly component where indicated, specified, or required to perform the functional requirements of the System, as specified. All Pilot Devices shall meet the following minimum specifications, unless otherwise noted.

1. All pilot devices shall be of heavy-duty, metallic, type 4/13, watertight/oiltight construction. Units shall mount through a 30.5 mm round hole.
2. All pilot devices shall have custom legends as shown. Legends shall be black with white letters, and letter height shall be minimum 3/16-inch-high characters.
3. All button and lens colors shall be as shown. Color code is as follows:
4. A = Amber, B = Blue, G = Green, R = Red, Y = Yellow, W = White
5. All pilot devices shall be equipped with a sufficient number of contact blocks to accomplish the switching functions specified.
6. All selector switches shall be knob type.
7. Illuminated selector switches shall be 120-volt AC, full voltage type with LED lamps where specified.

- B. Pushbuttons shall meet the following minimum specifications, unless otherwise noted.

1. All pushbuttons shall be flush type.
2. All emergency stop pushbuttons shall be red colored, jumbo mushroom head, push operate / twist release type, with one form C contact, minimum. Emergency stop

pushbutton legends shall be red with white letters, and letter height shall be minimum 3/16-inch-high characters.

3. Unless otherwise shown, all other pushbuttons shall be black in color.
 4. Illuminated push buttons shall be 120-volt AC, full voltage type with LED lamps where specified.
- C. Indicating lights shall meet the following minimum specifications, unless otherwise noted.
1. All indicating lights shall be full voltage type with LED lamps. Units shall be rated for the voltage shown.
 2. All indicating lights shall be "push-to-test" type.
 3. All indicating light lenses shall be plastic.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Install all components in accordance with manufactures specifications and instructions.
- C. Components shall be installed and tested on site in accordance with the requirements of Section 40 61 13 and in accordance with the manufacturer's recommendations.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Ensure proper installation per manufacturers recommendations

END OF SECTION

SECTION 40 78 53
RELAYS/TERMINAL BLOCKS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Quality Assurance
 - 3. Reference Standards
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Products
 - 7. Installation
 - 8. Testing

1.2 SCOPE

- A. This section specifies requirements for Auxiliary Relays used for control signal isolation and Terminal Blocks used for control conductor termination installed in control panels. And junction boxes.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer’s Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ICS-1 – General Standards for Industrial Control and System
- G. ICS-2 – Standards for Industrial Control Devices, Controllers and
- H. ICS-3 – Industrial Systems.
- I. UL – Underwriter’s Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)

1. Standard 508 (Industrial Control Panels for General Use).
 2. Standard 698 (Industrial Control Panels Relating to Hazardous (Classified) Locations)
 3. Standard 913 (Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations)
- J. NETA – National Electrical Testing Association.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. PROCEDURES: Section 01 33 00
- B. SUBMITTAL ITEMS FOR THIS SECTION:
 1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
 2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements,

with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

- C. Product Data: For each type of device and system:
 - 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- D. Manufacturer's installation instructions.
- E. Operation and Maintenance Manual if applicable.
- F. Warranty information.

1.6 PERFORMANCE REQUIREMENTS

A. RELAYS:

- 1. OPERATING CONDITIONS: Environmental and Hazardous Location ratings shall be determined by the ratings of the control apparatus for the installation where used. Where Relay does not meet these requirements a suitable enclosure shall be provided to meet the requirements.

B. TERMINAL BLOCKS:

- 1. OPERATING CONDITIONS: Environmental and Hazardous Location ratings shall be determined by the ratings of the control apparatus for the installation where used. Where Terminal block does not meet these requirements, a suitable enclosure must be provided that meets the requirements.
- 2. Terminal block shall be rated for the Voltage, Amperage, and Conductor size for the application requirements.

PART 2 PRODUCTS

2.1 RELAY CANDIDATE MANUFACTURERS

- A. Power and Master Control Relays
 - 1. Allen Bradley 700P/PK
 - 2. Square D 8501X/XM
 - 3. Approved Equal
- B. Plug-in Interposing/Auxiliary Relays

1. Idec RR/RJ Series
 2. Allen Bradley, Bulletin 700-HA/700-HB/700-HK
 3. Phoenix PLC-RIF/RSC
 4. Approved Equal
- C. Terminal Block Style Interposing/Auxiliary Relays
1. Idec RV8H series
 2. Allen Bradley, Bulletin 700-HLT
 3. Phoenix DEK
 4. Approved Equal
 - a. Units used with PLC outputs to be provided with leakage current suppression circuiting.
- D. Timing Relays for Auxiliary Control
1. Allen Bradley 700-FS/HR
 2. Approved Equal
- E. Submersible Pump Thermal/Leakage Relay
1. Flygt Panel Mountable Mini CAS 120
 2. Approved Equal
- F. Terminal Blocks
1. Allen-Bradley – 1492 J series
 2. Phoenix Contact – UK 5 series
 3. Entrelec
 4. Approved Equal

2.2 RELAYS GENERAL

- A. Relay contact ratings shall be evaluated for rated Voltage and Amperage per application needs to obtain minimum operational cycles:
1. Power and Master Control Relays
 - a. 10,000,000 mechanical operations and 1,000,000 electrical operations at rated load.
 2. Plug-in Interposing/Auxiliary Relays
 - a. 10,000,000 mechanical operations and 1,000,000 electrical operations at rated load.

3. Terminal Block Style Interposing/Auxiliary Relays
 - a. 10,000,000 mechanical operations and 1,000,000 electrical operations at rated load.
 4. Timing Relays for Auxiliary Control
 - a. 10,000,000 mechanical operations and 1,000,000 electrical operations at rated load.
 5. Submersible Pump Thermal/Leakage Relay
 - a. 10,000,000 mechanical operations and 1,000,000 electrical operations at rated load.
- B. Plug-in and Terminal Block Style Interposing/Auxiliary relays shall be Equipped with a push-to-test button and indicator light.
- C. Coil voltage shall match the control circuit voltage.

2.3 TERMINAL BLOCKS

A. GENERAL:

1. Terminal blocks shall be one-piece, molded, plastic blocks with screw-type terminals and barriers rated for 600 volts.
2. Unless otherwise specified, terminal blocks shall be cage clamp screw type. Terminals shall be provided with integral marking strips which shall be permanently identified with the connecting wire numbers as shown on the drawings.
3. Units must be rated for ampacity of wiring connected.
 - a. Minimum 20 amps unless otherwise noted.
4. Terminals shall be tin-plated. Insulating material shall be nylon.
5. Provide jumper bars for jumpering between terminal blocks.
6. Provide end clamps to separate and terminate terminal block groups. Provide end covers for groups of terminal blocks in sets to match the number points associated with individual I/O cards in the PLC block.
7. Provide Separation Plates on each side of terminals that are at a different potential or polarity than surrounding terminals.

8. Provide clear plastic DIN rail mounted nametag stanchions for each block of terminations. Each nametag shall hold a preprinted label designating the PLC bus and PLC block that terminates to that set of terminals.
9. Terminals shall be mounted such that there is a minimum of 1.5 inches of clear space on both sides of the terminal; for ease of wiring.
10. Provide wired terminals to match the number of points supplied on each installed I/O card or spare slot in a PLC cabinet.
11. Fuse terminal blocks shall be hinged disconnect level type with "blown fuse" indicators.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and install in accordance with manufacturer's instructions for the specified functional requirements.
- B. Components shall be installed and tested on site in accordance with the requirements of Section 40 61 13 and in accordance with the manufacturer's recommendations.
- C. Terminals shall be torqued to manufacturer specifications.
 1. Provide terminals for all wire connections to field wiring and internal power distribution.
 2. Terminals shall be DIN rail strip mounted. Provide number strips for terminal blocks that are referenced by the wire marker.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21.
- B. Relays shall be tested in accordance with the requirements of Section 40 61 21 and in accordance with the manufacturer's recommendations. Field calibration shall be conducted by a technical representative, factory trained and certified by the manufacturer.
- C. In addition, the units shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed system.

END OF SECTION

SECTION 40 78 56

ISOLATORS, INTRINSICALLY-SAFE BARRIERS, AND SURGE SUPPRESSORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Reference Standards
 - 3. Quality Assurance
 - 4. Submittals
 - 5. Performance Requirements
 - 6. Products Requirements
 - 7. Installation
 - 8. Testing
 - 9. Manufacturer's Services

1.2 SCOPE

- A. This Section covers the requirements for signal isolators, intrinsically safe barriers, intrinsically safe relays and surge suppressors.

1.3 REFERENCE STANDARDS

- A. ASTM – American Society for Testing and Materials
- B. NEMA – National Electrical Manufacturer's Association
- C. NEC – National Electrical Code
- D. NFPA No. 70, NEC - National Electrical Code
- E. NFPA No. 79, Electrical Standard for Industrial Machinery.
- F. ICS-1 – General Standards for Industrial Control and System
- G. ICS-2 – Standards for Industrial Control Devices, Controllers and
- H. ICS-3 – Industrial Systems.
- I. UL – Underwriter's Laboratory UL (Note: Other Nationally Recognized Testing Laboratories [NRTL], such as ETL, may be used in lieu of UL.)

1. Standard 508 (Industrial Control Panels for General Use).
 2. Standard 698 (Industrial Control Panels Relating to Hazardous (Classified) Locations)
 3. Standard 913 (Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations)
- J. NETA – National Electrical Testing Association.

1.4 QUALITY ASSURANCE

- A. REQUIREMENTS: Section 40 61 13 Process Control System General Provisions
- B. The manufacturer shall warranty the specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.5 SUBMITTALS

- A. Comply with applicable Submittal requirements specified in: Section 01 33 00.
- B. Product Data: For each type of device and system:
 1. Include product data sheets and equipment brochures showing standard products and specified accessories.
 - a. Mark data sheets to clearly show exact product and options being provided
- C. Manufacturer's installation instructions.
- D. Operation and Maintenance Manual

1.6 PERFORMANCE REQUIREMENTS

- A. REQUIREMENTS: Section 40 61 13
- B. OPERATING CONDITIONS: Section 40 06 70 instrument schedules.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. MTL Series 7700.
- B. Phoenix Contact.
- C. Weidmuller.

- D. Diversified Electronics.
- E. Pepperl + Fuchs
- F. Approved equal

2.2 GENERAL

- A. Intrinsically Safe Barrier specified is to comply with Section 40 61 13 requirements as well as those specified herein.
- B. Intrinsically safe devices (barriers/relays) shall be provided as a Panel Assembly component where indicated, specified, or required to perform the functional requirements of the System, as specified.
- C. General: All intrinsically safe devices shall be installed in accordance with applicable section of the NEC. Intrinsically safe wiring shall be separated from non-intrinsically safe wiring by at least 2-inches or by other means acceptable per the NEC. Intrinsically safe wiring must be identified, either by color coding, with light blue jacketed cable, or by tagging, at regular intervals, up to 25 feet. Non-intrinsically safe wiring shall not be connected to intrinsically safe terminations of intrinsically safe devices.

2.3 INTRINSICALLY SAFE BARRIERS:

- A. Transformer isolated barrier
 - 1. Containing a transformer to provide:
 - a. Complete isolation between safe and hazardous areas for loop powered devices.
 - b. 3 way isolation between safe area, hazardous area and power supply powered devices.
 - c. Resistor for current limitation.
 - d. Fuses for short circuit protection.
 - e. Provide barriers with pluggable connectors that are coded for easy replacement.
 - f. Transmission error shall be less than or equal to 0.1 percent of full scale.
 - g. DIN rail mounted on 35 millimeters DIN rail
 - h. Approvals:
 - 1) FM.
 - 2) UL 913.

- B. Intrinsically safe barriers shall conform to UL-913 or FM-3610 standards as approved by ETL, FM, MSHA, or UL features
 - 1. Provide and install intrinsically safe barriers/relays acceptable for use in Class I, Division 2, Group D, as required or indicated.
 - 2. Intrinsically safe barriers shall meet the following minimum specifications, unless otherwise noted.
 - a. Barrier designed to be used with 4-20 ma DC signals.
 - b. Solid State construction
 - c. DIN rail mounted.
 - d. FM approved
 - 3. Transmitter and converters for use with 4 to 20 milliamperes signals without Hart® communications capability:
 - a. Designed and approved for use with 4 to 20 milliamperes analog signals.
 - b. Designed for powering 2 and/or 3 wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
 - c. Supply voltage: 20 to 30 VDC.
 - 4. Transmitter and converters for use with 4 to 20 milliamperes signals with Hart® communications capability:
 - a. Designed and approved for use with 4 to 20 milliamperes analog signals.
 - b. Designed for powering 2 and/or 3 wire transmitters in hazardous locations and repeating and/or generating the current to the safe area.
 - c. Transfer digital signals from the hazardous area to the safe area.
 - d. Complete bi-directional communication between a smart transmitter located in the field and the suitable equipment located in the safe area.
 - e. Supply voltage: 20 to 30 VDC.

2.4 INTRINSICALLY SAFE RELAYS

- A. Intrinsically safe relays shall be fixed sensitivity type U/L approved for use with a remote pilot device (dry contact) located in Hazardous (Classified) areas.

1. Provide and install intrinsically safe barriers/relays acceptable for use in Class I, Division 1, Group C or D, as required or indicated.
 - a. Designed and approved for use with discrete inputs.
 - b. Supply power: 20 to 30 VDC.
 - c. Output to track input.
 - d. LED in the cover to indicate the status of the input.
 - e. Selector switch to change the logic of the input.
 - f. Input: Dry contact.
 - g. Output: SPDT relay.

2.5 SURGE PROTECTION DEVICES

1. Control panel power:
 - a. 120-volt control power source: Non-UPS powered:
 - 1) Provide surge protection device (SPD) for panel power entrances:
 - a) Nominal 120 VAC with a nominal clamping voltage of 200 volts.
 - b) Non-faulting and non-interrupting design.
 - c) A response time of not more than 5 nanoseconds.
 - 2) Control panel power system level protection, non-UPS powered:
 - a) Design to withstand a maximum 10 kA test current of a 8/20 μ s waveform according to IEEE C62.41.1 Category C Area.
 - b) For panels receiving power at 120 VAC, provide surge protection at secondary of main circuit breaker.
 - c) Provide both normal mode noise protection (line to neutral) and common mode (neutral to ground) surge protection.
 - d) DIN rail mounting.
 - e) Attach wiring to the SPD by means of a screw type cable-clamping terminal block:
 - (1) Gas-tight connections.

- (2) The terminal block: Fabricated of non-ferrous, non-corrosive materials.
 - f) Visual status indication of MOV status on the input and output circuits.
 - g) Dry contact rated for at least 250 VAC, 1 Amp for remote status indication.
 - h) Meeting the following requirements:
 - (1) Response time: Less than or equal to 100 ns.
 - (2) Attenuation: Greater than or equal to -40 dB at 100 kilovolt-hertz as determined by a standard 50 ohms insertion test.
 - (3) Safety approvals:
 - (a) UL 1283 (EMI/RFI Filter).
 - (b) UL 1449 2nd Edition.
 - i) Manufacturer: One of the following or equal:
 - (1) Phoenix Contact type SFP TVSS/Filter.
 - (2) Liebert Accuvar series.
 - (3) Islatrol.
- b. 120-volt control power source: UPS powered.
- 1) Provide surge protection on the control power source at each panel containing power supplies, or electronic components including PLCs, I/O, HMI, and digital meters.
 - 2) Location:
 - a) For panels with a UPS, install surge protection ahead of UPS and maintenance bypass switch.
 - (1) Surge protection is not required for 120 VAC circuits that are only used for panel lights and receptacles.
 - b) For panels receiving power at 480 VAC, provide surge protection on the 120 VAC control power transformer secondary.
 - 3) MCOV: 150 VAC.

- 4) Surge capability (8/20 microsecond wave): 10 kA.
 - 5) Peak let-through: 620V L-N, 850V L-G.
 - 6) Manufacturer: One of the following or equal:
 - a) Phoenix Contact Plugtrab PT series
 - b) MTL Surge Technologies MA15 series
2. Instrument, data and signal line protectors (traditional I/O) – panel mounted:
- a. Surge protection minimum requirements: Withstand a 10-kA test current of a 8/20 μ s waveform in accordance with IEEE C62.41.1 Category C Area.
 - b. DIN rail mounting on 35 millimeters rail (except field mounted SPDs).
 - c. SPDs consisting of 2 parts:
 - 1) A base terminal block.
 - 2) A plug protection module:
 - a) Replacing a plug shall not require the removal of any wires nor interrupt the signal.
 - b) Base and plug coded to accept only the correct voltage plug.
 - d. SPD Manufacturer: One of the following or equal:
 - 1) Phoenix Contact Plugtrab Series.
 - 2) Bournes Series 1800.
3. Instrument, data and signal line protectors (traditional I/O)– field mounted:
- a. Surge protection minimum requirements: Withstand a minimum 10 kA test current of a 8/20 μ s waveform in accordance with IEEE C62.41.1 Category C Area.
 - b. Manufacturer: One of the following or equal:
 - 1) Plugtrab PT Series
 - 2) MTL TP48 Series.

2.6 SIGNAL ISOLATORS AND CONVERTERS

- A. Furnish signal isolators that provide complete isolation of input, output, and power input:
1. Minimum isolation level: 1.5 kilovolts AC/50 hertz for at least 1 minute.
 2. Independently adjustable span and zero.
 3. Accuracy including linearity and hysteresis within 0.1 percent max at 25 degrees Celsius.
 4. Operating temperature: 0 degrees Celsius to 55 degrees Celsius.
 5. Supply power: 9 to 30 VDC.
 6. Output capable of driving loads up to 500 ohms
 7. Field selectable for current or voltage input and current or voltage output
 - a. 4-20 mA input – 1 to 5 VDC out
 - b. 1 to 5 VDC input - 4-20 mA out
 - c. 0 – 10 VDC input – 0-20 mA out
 - d. 0-20 mA input – 0-10 VDC out
 8. Ambient temperature range: -20 degrees Celsius to +65 degrees Celsius.
- B. Manufacturer: One of the following or equal:
1. Phoenix Contact MCR Series.
 2. Acromag 1500, 600T, 800T, Flat Pack or ACR Series.
 3. Action Instruments Q500 Series or Ultra SlimPakII.
 4. AGM electronics Model TA-4000.

PART 3 EXECUTION

3.1 INSTALLATION

- A. REQUIREMENTS: Section 40 61 13 and Install in accordance with manufacturer's instructions for the specified functional requirements.

- B. Barriers shall be installed, calibrated and tested on site in accordance with the requirements of Section 40 61 21 and 40 61 26 and in accordance with the manufacturer's recommendations.
- C. Install Barriers, Isolators and surge suppressors per manufacturer's instructions.

3.2 TESTING

- A. REQUIREMENTS: Section 40 61 21
- B. Ensure proper installation per manufacturers recommendations
- C. In addition, the devices shall be operationally tested in conjunction with the functional acceptance test of the complete system of Instrumentation and Controls for the completed well system.

END OF SECTION

SECTION 40 78 59

POWER SUPPLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope.
 - 2. Reference Standards.
 - 3. Quality Assurance.
 - 4. Submittals.
 - 5. Products Requirements.
 - 6. Installation.
 - 7. Testing.

1.2 SCOPE

- A. This section specifies requirements for Panel mounted 120 Vac input, 120 Vac and 24 Vdc outputs are specified herein or shown on the drawings.
- B. Refer to Local Control Panels - Section 26 27 16 that specifies requirements for manufacturer, vendor, and Contractor provided panels that include motor controllers, combination motor starters, control devices, and logic devices as shown on the electrical drawings. These requirements apply to this section as well.
- C. The manufacturer shall warranty the above specified equipment for twelve months from equipment start-up or eighteen months from date of shipment, whichever occurs first, to be free from defects in design workmanship or materials.

1.3 REFERENCE STANDARDS:

- A. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
NEMA 250	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 94	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 508A	Industrial Control Panels
UL 698A	Industrial Control Panels Relating to Hazardous (Classified) Locations

1.4 QUALITY ASSURANCE

A. REQUIREMENTS: Section 40 61 13.

B. PROCEDURES: Section 01 33 00

C. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.
 - a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration

D. Product Data: For each type of device and system:

1. Include product data sheets of equipment, devices, and materials requested by the individual specification sections.
 - a. Catalog information shall include technical specifications and application information, including ratings, range, weight, accuracy, etc.
 - b. Catalog cuts shall be edited to show only the items, model numbers, and information which apply.
 - c. Catalog cuts shall be assembled in a tabbed three ring binder. Each binder shall contain a cover sheet and index listing the sub- mitted items and cross-referenced to the appropriate specification paragraph. Where submittal information for equipment or materials covered by more than one specification Section is included within one binder, each tab shall be submitted as a separate submittal number. The tab shall be labeled with the submittal number.
 - d. Where submittals are made electronically in PDF format, the PDF shall be organized by specification section and linked to an index. The PDF shall be searchable.
- E. Submittal items required include:
 1. Manufacturer's installation instructions.
 2. Operation and Maintenance Manual if applicable
 3. Connection Diagrams.
 4. Power supply calculations.

PART 2 PRODUCTS

2.1 DIRECT-CURRENT POWER SUPPLIES

- A. Convert 120 VAC to 24-volt DC or other DC voltages required or as required for the application.
- B. Sized to provide 40 percent excess rated capacity.
- C. Sized as shown on the drawings as a minimum. Provide calculations to show anticipated load does not exceed 70% of power supply rating.
- D. UL 508C listed to allow full rated output without de-rating.
- E. FEATURES:

1. Convection-cooled linear type or switching type.
2. Line regulation: 0.4 percent for line variations from 105 to 132 volts.
3. Load regulation: 0.4 percent for load variations from 0 to full load.
4. Output regulation: Within 0.05 percent for a 10 percent line change or a 50 percent load change:
5. Ripple and noise: Not exceed 100 mV peak-to-peak.
6. Hold-up time at maximum load: Not less than 16 milliseconds.
7. Continuous duty from 0 to 50 degrees C at rated load.
8. Provide a minimum of 1 set of dry contacts configured to change state on failure for monitoring and signaling purposes.
9. Output electronically current limited.
10. Over-voltage crowbar shutdown.
11. Output voltage:
 - a. Rated 24 - 28 Vdc.
 - b. Adjustable plus or minus 5 percent.
 - c. Set to provide 24.0 volts.

F. MANUFACTURERS:

1. Sola
2. Allen Bradley
3. PULS
4. Phoenix Contact
5. As shown on the drawings
6. Approved equal.

2.2 REDUNDANCY MODULES

- A. Provide a redundancy module where shown on the contract drawings or as required by this specification.

- B. A redundancy module is required where two power supplies are installed in the same control panel for redundancy purposes.
- C. Where a redundant power supply is required, each power supply will be capable of providing full power to the control panel.
- D. The redundancy module shall be made by the same manufacturer as the power supply.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install all components in accordance with manufactures specifications and instructions.

3.2 TESTING

- A. A. Power Supplies shall be tested in accordance the manufacturer's recommendations.

END OF SECTION

SECTION 40 80 00

COMMISSIONING OF PROCESS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Scope
 - 2. Quality Assurance
 - 3. Submittals
 - 4. Products
 - 5. Testing
 - 6. Functional Checkout

1.2 SCOPE

- A. This section specifies the acceptance testing of the process control materials, equipment, and systems. Provide all labor, tools, material, power, and other services necessary to provide the specified tests. All testing described in this section shall be coordinated with the requirements of Section 01 75 16 Start Up Procedures, 26 08 00 Commissioning of Electrical Systems and 40 61 21 Process Control System Testing.
- B. Provide the labor, tools, material, power, and services necessary to provide the process instrumentation and control system inspection and testing specified herein. Coordinate all test procedures with the requirements of Section 01 75 16. Include the following action items:
 - 1. Develop test plan.
 - 2. Develop record keeping system.
 - 3. Coordinate testing with Vendor package equipment.
 - 4. Coordinate testing with the Owner's Systems Programmer.
- C. Testing to include:
 - 1. Pre-Operational - Factory Acceptance Testing (FAT)
 - 2. Component Testing Sequence:
 - a. Wiring Testing

- b. Network and Bus Cable System Inspection and Testing
 - c. Piping Testing
 - d. Installation Inspection
 - e. Instrumentation Calibration
 - f. Loop Testing
 - g. Network Testing
3. System (Functional) Testing Sequence:
- a. Process Control Strategy/Sequence Testing
 - b. Control System Closed Loop
 - c. Functional Checkout
4. Operational Testing:
- a. System Acceptance Testing (SAT)

1.3 QUALITY ASSURANCE

A. TESTING MANAGER:

1. The Contractor or Systems Integrator shall appoint a qualified specialist as Testing Manager to manage, coordinate, and supervise the testing work.
2. The Testing Manager requires at least 5 years of total experience, or experience on at least five separate projects, in managing the testing and startup of electrical and instrumentation control systems of equal or greater scope and complexity. PICS Testing Manager to provide a quality assurance program which includes:
 - a. Definition of process areas and systems, with testing executed on an area-by-area basis, based on the P&ID or drawings if available.
 - b. Sequential list of the test phases required for each process area and system.
 - c. Completion status tracking form by process area, system, and test phase.

B. REFERENCE STANDARDS:

1. This Section incorporates by reference the latest revisions of the following documents. They are part of this Section insofar as specified and modified herein.

In the event of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail.

2. Unless otherwise specified, references to documents shall mean the documents in effect on the effective date of the Agreement. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by that organization or, if there are no replacement documents, the last version of the document before it was discontinued.

Reference	Title
ANSI/NETA ATS-2009	Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment Systems

C. APPLICATION:

1. Where testing in accordance with this section and other Division 26 and 40 Sections is required, the required tests, including the retesting after the correction of found defects must be complete, and the submittal of final test reports to the Owner for review shall be completed prior to the energizing of material, equipment, or systems.

1.4 SUBMITTALS

A. PROCEDURES: Section 01 33 00

B. SUBMITTAL ITEMS FOR THIS SECTION:

1. Review of Shop Drawings and Brochures shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from Contract Document requirements. It shall be clearly understood that the noting of some errors, but the overlooking of others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Documents shall govern and are not waived or superseded in any way by the review of the Shop Drawings and Brochures.
2. Where submitted items deviate from specification requirements, a list of any specification sections that are not being met by the submitted item must be provided. The list is to be organized by specification section and paragraph and shall list the product requirement and in what way submitted item does not comply with the requirement. A detailed written explanation of the reasons for requesting the deviation must also be included.

- a. The Owner shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance with the specifications.
 - b. Failure to include a list of the specification section deviations along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration.
3. Proposed testing procedures including proposed test report forms in accordance with 40 61 21 Process Control System Testing.
 - a. Test reports including documentation for all tests performed. Test reports shall be submitted for review prior to the equipment being energized.
 - b. Execution plan including schedule.
 - c. Test results for a specific piece of equipment as required by the equipment specification shall also be included in the operation and maintenance manual(s).
 4. All testing required herein and the test results shall also be submitted and documented as required under Sections 01 75 16, 26 05 00, 40 61 21 and where identified within specific sections.

PART 2 PRODUCTS

2.1 TESTING EQUIPMENT AND INSTRUMENTS

- A. The test equipment, instruments and devices used for testing shall be calibrated to test equipment standards with references traceable to the National Institute of Standards and Technology. The test equipment, instruments and devices shall have current calibration stickers indicating date of calibration, deviation from standard, name of calibration laboratory and technician, and date of next recalibration.

2.2 PRODUCT DATA

- A. The following information shall be provided in accordance with Section 01 33 00 and Section 01 75 16:
 1. Defects: Notify the Owner of any material or workmanship found defective within 24 hours of discovery.
 2. Short circuit analysis and protective device curves.

3. Test reports: Provide the report required in NETA ATS-2009 paragraph 5.4. Results shall be placed on the forms specified in this Section. Test reports shall also be part of the operation and maintenance manuals.

PART 3 EXECUTION

3.1 TESTING

A. GENERAL

1. Ensure that all electrical system testing performed is in strict conformance with the electrical acceptance tests specified in Section 26 08 00. Contact the Owner 10 days prior to the testing to allow witnessing of all tests.
2. The test measurements shall be recorded on specific forms for the subject test.
3. Testing shall be per ANSI/NETA ATS 2009. Provide testing data sheet for the following:
 - a. Switchboard assemblies.
 - b. Transformers – Small Dry-type, air cooled (600 VAC and below, 30 kVA and larger)
 - c. Cables – Low voltage (600 VAC maximum)
 - d. Circuit breakers – Low voltage (Insulated Case/Molded Case)
 - e. Protective Relays
 - f. Instrument Transformers
 - g. Metering and Monitoring Equipment
 - h. Grounding Systems
 - i. Ground Fault Protection Systems
 - j. Rotating Machinery
 - k. Motor Control
 - l. Variable Speed Drive Systems
 - m. Outdoor Generator Systems
 - n. Uninterruptable Power Systems

- o. Manual and Automatic Transfer Switches

END OF SECTION

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

SECTION 43 21 00
LIQUID PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. The provisions of this Section shall apply to all pumps and pumping equipment except where otherwise indicated.
- B. Where two or more pump systems of the same type or size are required, all pumps shall all be produced by the same Manufacturer.
- C. Provide all labor, equipment and materials and perform all operations in connection with the installation and testing of pumps selected by the Owner.
- D. Coordinate and utilize all factory testing, installation, start-up, and field-testing services supplied in conjunction with the pumping equipment.
- E. All work performed under this Section shall be in accordance with all approved trade practices and Manufacturer's recommendations.
- F. Section includes:
 - 1. General design requirements for liquid pumps.
 - 2. Factory testing.
- G. Related Sections:
 - 1. Section 43 21 10 – Vertical Turbine Pumps
 - 2. Section 43 21 39 – Deep Well Submersible Pumps

1.2 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, Submittal Procedures.
- B. Shop Drawings: Provide the following information:
 - 1. Pump name, identification number, and applicable Section number from Project specifications.
 - 2. Performance Data Curves:

- a. Showing head, capacity, horsepower demand, net positive suction head (NPSH) required and pump efficiency over the entire operating range of the pump.
 - b. Pump Manufacturer shall indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the design flow conditions and the maximum and minimum flow conditions.
 - c. A family of performance curves at intervals of 100 revolutions per minute (rpm) from minimum speed to maximum speed shall be provided for each pump equipped with a variable speed drive, and a curve for each speed on two-speed pumps.
3. The limits on the performance curves recommended for stable operation without surge, cavitation, or excessive vibration, known as the Acceptable Operating Range (AOR), per the Hydraulic Institute.
 4. Assembly and Installation Drawings: Including shaft size, seal, coupling, bearings, anchor bolt plan, part nomenclature, material list, outline dimensions, and shipping weights.
- C. Complete motor nameplate data as defined by National Electrical Manufacturers' Association (NEMA), Motor Manufacturer and any motor modifications.
 - D. Operation and Maintenance Manual: Containing the required information for each pump section.
 - E. Spare Parts List: Containing the required information for each pump section.
 - F. Factory Test Data: Signed, dated, and certified for each pump system which requires factory testing submitted before shipment of equipment.
 - G. Certifications:
 1. Manufacturer's certification of proper installation.
 2. Contractor's certification of satisfactory field testing.
 - H. All pump motor information as required in Division 43.
 - I. Provide lateral and torsional analysis as specified under Submittals Article of Section 11 05 00, Common Work Results for Equipment.

PART 2 PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be standard products of a manufacturer and distributor regularly engaged in the manufacture and distribution of such products for at least 2 years and shall be suitable for the service intended.
- B. All materials and equipment shall be new and unused except for the testing specified herein.
- C. Compliance with the requirements of the individual pump sections may necessitate modifications to the Manufacturer's standard equipment.
- D. All centrifugal pumps shall have a continuously rising performance curve. In no case shall the required horsepower at any point on the performance curve exceed the rated horsepower of the motor or engine or encroach on the service factor.
- E. All components of each pump system provided under the pump sections shall be entirely compatible. Each unit of pumping equipment shall incorporate all basic mechanisms, couplings, electric motors or engine drives, variable speed controls, necessary mountings, and appurtenances.
- F. The pumps shall be supplied by a distributor authorized to service them throughout the warranty period and beyond. The distributor shall be located within a 100-mile radius of the site.
- G. The pumps shall be warranted by the Manufacturer for a minimum of 1-year from the date of installation.
- H. All materials and coatings coming in contact with potable water shall be ANSI/NSF Standard 61 approved.
- I. The pumping units shall all be supplied by one manufacturer and shall be complete including pumps, motors, suction cans, baseplates, couplings, guards, and other accessories.
- J. The complete pump assembly shall be designed and built for continuous service at any and all points within the specified range of operation, without overheating, without damaging cavitation, and without excessive vibration or noise.

2.2 MATERIALS

- A. All materials shall be suitable for the intended application; materials not specified shall be high-grade, standard commercial quality, free from all defects and imperfection

that might affect the serviceability of the product for the purpose for which it is intended, and shall conform to the following requirements:

1. Cast iron pump casings and bowls shall be of close-grained gray cast iron, conforming to ASTM A 48 - Gray Iron Casings, Class 30, or equal.
2. Stainless steel pump shafts shall be Type 416 or 316.
3. Miscellaneous stainless steel shall be of Type 316, except in a septic environment.
4. Anchor bolts, washers, and nuts supplied by the Contractor for non-corrosive applications shall be galvanized steel in accordance with the requirements of Section 05 50 00, Metal Fabrications. Anchor bolts, washers, and nuts in corrosive service applications shall be stainless steel in accordance with that Section.

2.3 PUMP COMPONENTS, GENERAL

- A. Flanges: Suction and discharge flanges shall conform to ANSI/ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings, Class 12, 125, 250, and 800 or B16.5 - Flanges and Flanged Fittings dimensions.
- B. Handholes: Handholes on pump casings shall be shaped to follow the contours of the casing to avoid any obstructions in the water passage.

2.4 PUMP APPURTENANCES

- A. Nameplates: Each pump shall be equipped with a stainless steel nameplate indicating serial numbers, rated head and flow, impeller size, pump speed, and Manufacturer's name and model number.
- B. Gauges: Provide and install pressure gauges as shown on the Drawings.
 1. All pumps (except sample pumps, sump pumps, hot water circulating pumps, and chemical metering pumps) shall be equipped with pressure gauges on the pump discharge.
 2. Pump suction lines shall be provided with compound gauges.
 3. Gauges shall be located in a representative location, where not subject to shock or vibrations, in order to achieve true and accurate readings.
 4. Isolation diaphragms shall be provided for all gauges except where pumping potable water.
 5. Where subject to shock or vibrations, the gauges shall be wall-mounted or attached to galvanized channel floor stands and connected by means of flexible connectors.

2.5 FACTORY TESTING

- A. The following tests shall be conducted on each indicated pump system:
1. Pump Systems: All pump systems 50 horsepower (hp) and larger shall be tested at the pump factory in accordance with the American National Standard for Rotodynamic Pumps For Hydraulic Performance Acceptance Tests (ANSI/HI 14.6) as approved by American National Standards Institute (ANSI) and published by the Hydraulic Institute.
 2. Tests shall be performed using the complete pump system to be furnished, including the motor.
 3. For motors 100 hp and smaller, the Manufacturer's certified test motor shall be acceptable. The following minimum test data shall be submitted:
 - a. Hydrostatic test data.
 - b. A minimum of five hydraulic test readings between shutoff head and 25 percent beyond the maximum indicated capacity, recorded on data sheets as defined by the Hydraulic Institute.
 - c. Pump curves showing head, flow, brake horsepower (bhp), efficiency and NPSH requirements.
 - d. Certification that the pump horsepower demand did not exceed the rated motor hp beyond the 1.0 service rating at any point on the curve.
 - e. Pump test data curves showing head, flowrate, bhp, and efficiency. Acceptance level shall be Grade 1E as defined by ANSI/HI 14.6.
 4. Factory Witnessed Tests: Factory witnessed testing for this Project not required.
 5. Acceptance: In the event of failure of any pump to meet any of the requirements, the Contractor and Pump Manufacturer shall make all necessary modifications, repairs, or replacements to conform to the requirements of the Contract Documents and the pump shall be retested at no additional cost to the Owner until found satisfactory.
- B. The Pump Manufacturer shall complete a lateral and torsional analysis where required and as specified in the Submittal Article of Section 11 05 00, Common Work Results for Equipment. This analysis shall identify the dry and wet lateral critical and the torsional critical speeds of the pump system and shall be submitted for review as part of the pump submittal.

PART 3 EXECUTION

3.1 SERVICES OF PUMP MANUFACTURER

- A. An authorized service representative of the Manufacturer shall visit the Site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:
 - 1. Installation of the equipment.
 - 2. Inspection, checking, and adjusting the equipment.
 - 3. Startup and field testing for proper operation.
 - 4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.
 - 5. Requirements are more specifically detailed herein and in individual pump specifications.

- B. Instruction of the Owner's Personnel:
 - 1. An authorized training representative of the Manufacturer shall visit the Site to instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment.
 - 2. Instruction shall be specific to the models of equipment provided.
 - 3. The Pump Manufacturer's representative shall have at least 2 years' experience in training.
 - 4. Training shall be scheduled a minimum of 3 weeks in advance of the first session.
 - 5. Proposed training material and a detailed outline of each lesson shall be submitted for review. Comments shall be incorporated into the material.
 - 6. The training materials shall remain with the trainees.
 - 7. The Owner may videotape the training for later use with the Owner's personnel.

3.2 INSTALLATION

- A. General: Pumping equipment shall be installed in accordance with the Manufacturer's written recommendations.

- B. Alignment:

1. All equipment shall be field tested to verify proper alignment, operation as specified, and freedom from binding, scraping, vibration, shaft runout, or other defects.
 2. Pump drive shafts shall be measured just prior to assembly to ensure correct alignment without forcing.
 3. Equipment shall be secure in position and neat in appearance.
- C. Lubricants: Provide the necessary oil and grease for initial operation.

3.3 FIELD TESTS

- A. Each pump system shall be field tested after installation to demonstrate satisfactory operation without excessive noise, vibration, cavitation, or overheating of bearings.
- B. Field testing methods and allowable tolerances shall comply with current version of the Hydraulics Institute standards for the type of pumps installed.
- C. The following field testing shall be conducted:
 1. Startup, check, and operate the pump system over its entire speed range. Where vibration analysis and measurement are required, it shall be within the amplitude limits specified and recommended by the Hydraulic Institute Standards at a minimum of four pumping conditions defined by the Engineer.
 2. Obtain concurrent readings of motor voltage, amperage, pump suction head and pump discharge head for at least four pumping conditions at each pump rotational speed. Check each power lead to the motor for proper current balance.
 3. Determine bearing temperatures by contact type thermometer. A run time of at least 20 minutes shall precede this test unless insufficient liquid volume is available.
 4. Electrical and instrumentation tests shall conform to the requirements of the Section under which that equipment is specified.
 5. Field vibration readings shall be conducted by an Owner-selected certified testing agency, paid for by the Contractor, with readings taken at the following positions with the average not exceeding the current Hydraulic Institutes standards for the type of pump installed.
 - a. Measurements shall be taken at the locations as specified in the current Hydraulic Institute standards for the type of pump installed.
 6. Provide written proof of vibration readings and provide test data.

- D. Field testing will be witnessed by the Engineer. The Contractor shall furnish 3 days' advance notice of field testing.
- E. In the event any pumping system fails to meet the test requirements, it shall be modified and retested as above until it satisfies the requirements.
- F. After each pumping system has satisfied the requirements, the Contractor shall certify in writing that it has been satisfactorily tested and that all final adjustments have been made. Certification shall include the date of the field tests, a listing of all persons present during the tests, and the test data.
- G. Contractor shall bear all costs of field tests, including additional services of the Manufacturer's representative required beyond those specified.

END OF SECTION

**SECTION 43 21 10
VERTICAL TURBINE PUMPS**

PART 1 GENERAL

1.1 DESCRIPTION

The Work covered in this Section includes furnishing, installing, start-up and operation training for vertical turbine pumps of barrel or can (lineshaft) type. Vertical turbine pumps shall be of the open lineshaft and fresh water lubricated type. Like items of equipment specified herein shall be the end product of one manufacturer. Electrical controls and motor design requirements are specified in this section and the electrical section of these specifications. The pump supplier shall be responsible for coordinating the pump requirements with the pump drive manufacturer and shall be responsible for the overall pump and drive requirements.

1.2 SUBMITTALS DURING CONSTRUCTION

A. Shop drawing submittals shall be made in accordance with Section 01 33 00 - Submittals, and Section 43 21 00 – Liquid Pumps.

1.3 REFERENCE SPECIFICATIONS, CODES AND STANDARDS

Pumps shall meet the requirements of the latest version of ANSI/AWWA E-103, Horizontal and Vertical Line-Shaft Pumps and the Hydraulic Institute Standards, except where modified herein.

1.4 VIBRATION ANALYSIS AND TESTING

Pump vendor shall provide vibration analysis per Paragraph 2.5 A. within Section 43 21 00 – Liquid Pumps. Lateral and torsional analysis shall be provided per Paragraph 2.5 B. within specification 43 21 00 – Liquid Pumps. Field vibration measurements during field testing of each pump-motor unit shall be provided per section 3.3 of specification 43 21 00 – Liquid Pumps.

1.5 WARRANTY

A. The pump manufacturer shall warrant the pump and motor assemblies against material and workmanship defects for a period of 1 year which commences at acceptance of the pump installation. Submit the manufacturer's warranty document prior to installation.

PART 2 PRODUCTS

2.1 DESCRIPTION

A. Identification:

Location	Pump Room
Pump Label(s)	Booster Pump 1, Booster Pump 2
Quantity	2

B. Performance Requirements at Full Pump Speed:

Maximum Shutoff Head (ft)	234'
Design Flow Capacity and Head:	
Duty Point 1(@ 70% BEP Flow)	910 gpm @ 200 ft GDH
Primary Duty Point (@ BEP Flow)	1,250 gpm @ 180 ft TDH
Duty Point 2 (@120% BEP Flow)	1,560 gpm @ 148 ft TDH
Minimum Bowl Efficiency:	
Duty Point 1(@ 70% BEP)	77%
Primary Duty Point (@ BEP)	83%
Duty Point 2 (@120% BEP)	80%
Maximum Pump Speed (rpm)	1800
Maximum Motor Size (hp)	75

C. Performance Requirements at Variable Speed:

Duty Point 3 (Between 70% and 100% pump speed and within POR)	750 gpm @ 180.3 TDH
Minimum Guaranteed Pump Speed	70% of Max Pump Speed

D. Operating Conditions:

Duty	Continuous
Drive	Variable Frequency Drive (Variable Speed)
Ambient Environment	Indoor
Ambient Temperature	33° - 104° F
Fluid Service	Potable Water

Fluid Temperature	33° - 65° F
Fluid pH Range	6.0 to 8.5
Fluid Specific Gravity	1.0
Fluid Viscosity (absolute) (centipoises at 60° F)	1.12
Pump Station Floor Elevation	421.33 ft
Pump Discharge Centerline Elevation	423.33 ft
Suction Pressure Range	11-18 psi

E. Pump Dimensions:

Suction Diameter on Suction Barrel (in)	12
Suction Flange Rating (ANSI or AWWA)	AWWA CLASS F
Discharge Diameter (in)	8
Discharge Flange Rating (ANSI or AWWA)	250 lb (ANSI)
Minimum Column Shaft Diameter (in)	1.25
Minimum Pump Bowl Shaft Diameter (in)	1.94
Minimum Column Diameter (in)	8
Minimum Suction Barrel Diameter (in)	20
Maximum Pump Bowl Assembly Diameter (in)	11.5
Minimum Setting (ft) (Distance from underside of discharge head or base plate to column pipe connection at bowl assembly)	As required based on pump can length as shown on drawings

F. Other Requirements

1. The head-capacity curves shall exhibit a uniformly rising characteristic from free discharge to shutoff. The pump motors shall be non-overloading throughout the entire pump curve.
2. Each pump model shall have pump cans that are equal in size and shall be sized by the pump manufacturer.
3. Verify all dimensions and elevations prior to submittals.

2.2 PUMP CONSTRUCTION

- A. The bowls for all pumps shall be cast-iron, all wetted parts shall be lined and coated with a one part, heat curable, thermosetting epoxy coating designed for corrosion protection of metal. The epoxy shall be applied as a dry powder which melts and cures

to the surface to create a uniform thickness. The lining and coating shall be NSF 61 approved Skotchkote 134, manufactured by 3M.

- B. The impellers shall be 316 SST and shall be statically and dynamically balanced. They shall be securely fastened to the shaft with tapered lock collets, threaded lock collets or double keys. The impellers shall be adjustable vertically by external means at the driver location.
- C. Impeller and pump bowl wear rings shall be provided. The wear rings shall be ASTM B62 UNS C83600 bronze and replaceable.
- D. The bowl shaft shall be stainless steel, Type ~~410, 416, or 316~~.
- E. The suction bell shall be cast-iron with a bottom bearing and streamlined ribs. Epoxy lining and coating shall be the same as bowls.
- F. The column pipe shall be not less than Schedule 40 steel pipe. The column pipe shall be epoxy lined and coated and flanged with registered fit and through bolting. Epoxy lining and coating shall be same as bowls. Pipe sections shall not exceed 10 feet in length.
- G. The line shaft and couplings shall be Type 416 stainless and sized such that the natural frequency of the shaft is avoided by a minimum 25 percent throughout the entire operating range. Line shaft sections shall not exceed 10 feet in length.
- H. Line shaft lubrication shall be by water.
- I. The shaft seal shall be a mechanical type seal and equipped with non-clogging, single coil springs and non-sliding, internal, secondary elastomers. Metal parts shall be Type 316 stainless steel alloy 20, or Hastelloy B or C. Sealing materials shall be carbon and ceramic. Seal container shall be machined with a boss for centering the mechanical seal gland and holding it in place. Seal to be equipped with flush, Quench and drain ports. Flush port shall be piped back to the suction can with SS tubing complete with restriction port.
- J. The line shaft bearings shall be rubber with bronze retainers at each joint for open line shaft.
- K. The discharge head shall be manufacturer's standard fabricated steel. Fabricated steel discharge head shall be reinforced to withstand pipe thrust, fusion bonded lined and coated and shall include flange and base plate. Lining and coating shall be the same as bowls. Forged steel half-couplings for air valve, pressure switch and drain connections shall be a minimum of 1 1/4-inch and 3000 lbs.
- L. The motor shaft coupling shall be a 4-piece, heavy-duty adjustable spacer coupling, to allow for mechanical seal removal, with machined registered fit per pump

manufacturer and complying with ANSI/AWWA E-103 and ANSI/HI 2.1 through 2.5 specifications.

- M. The bottom bearing shall be a close tolerance sleeve type conforming to ANSI/AWWA E-103 and ANSI/HI 2.1 through 2.5 specifications with a length minimum of 2 1/2 times shaft diameter. Suction case shall be permanently grease lubricated with non-soluble grease.
- N. The bowl and suction case bearings shall be of the bronze sleeve type.

2.3 SUCTION BARREL

- A. The suction barrel shall be of fabricated steel, schedule 20 pipe and lined and coated with NSF approved fusion bonded epoxy, with an extra-heavy carbon steel mounting plate, drilled and tapped to match the discharge head. Suction inlet spool shall have plain end with lay length as required for installation with flange coupling. Suction barrel shall come equipped with flow vanes. Any required anchors at the top or bottom of the barrel shall be coordinated with the drawings by the Contractor.
- B. Suction Barrel Sizing

The required minimum free area between pump and suction barrel listed above shall determine the required diameter of the fabricated suction barrels. The length of the barrel shall be determined by minimum measurements as shown on the drawings or the minimum pump setting specified under pump dimensions herein.

2.4 MOTORS

Each pump shall be provided with a vertically mounted electric motor that conforms to the following requirements and the specifications in Division 26. In the event of conflicts, the more restrictive specification shall apply. The brake horsepower required by the driven equipment anywhere on the pump curve shall not exceed the rated nameplate horsepower of the motor. The ratings indicated are minimums. Motors shall be designed to accept the total, unbalanced thrusts imposed by the pump.

- A. Motor Type: Vertical, solid shaft, squirrel cage induction type, premium efficiency.
- B. Shaft Coupling: Adjustable spacer coupling between pump and motor
- C. Installation Environment: Damp
- D. Horsepower: Maximum horsepower is specified table 2.1B above.
- E. Synchronous Speed: Not to exceed 1800 RPM for vertical turbine pumps.
- F. Rated Voltage: 480 under most circumstances

- G. Phase/Frequency: 3/60
- H. Enclosure: WP-1 with screen
- I. Ambient Temperature: 40 degrees C, continuous
- J. Service Factor: 1.15
- K. Inverter Duty rated
- L. Optional Accessories:
 - 1. Oversize the main terminal (conduit) box and provide grounding terminal in conduit box.
 - 2. Non-reverse ratchet
 - 3. Overtemperature protection thermostats

2.5 SPARE PARTS

The pumps shall be provided with the following spare parts for each pump:

One Mechanical Seal.

2.6 MANUFACTURERS

- A. Pumps shall be manufactured by Trillium Floway Pumps, or equal.
 - 1. P2 & P3 – Basis of design pump: Trillium Floway Vertical – 14JKH, 4 Stage Bowl Assembly

PART 3 EXECUTION

3.1 SERVICES OF MANUFACTURER

- A. Installation -- The service representative of the manufacturer shall be continuously present at the site to supervise the assembly and installation of the pumps.
- B. Inspection, Startup and Field Adjustment -- The service representative of the manufacturer shall be present at the site for not less than 3 work days in addition to those days provided in the previous paragraph, to furnish the services required by Section 43 21 00 - Liquid Pumps. Coordinate with Owner.
- C. Instruction of Owner's Personnel -- The training representative of the manufacturer shall be present at the site for 1 work day in addition to those days provided in the

previous paragraph, to furnish services required by Section 43 21 00 - Liquid Pumps. Coordinate with Owner.

- D. For the purposes of this paragraph, a work day is defined as an eight hour period at the site, excluding travel time.
- E. The Owner's Representative may require that the inspection, startup, and field adjustment services above be furnished in three separate trips.
- F. The pump manufacturer shall provide field vibration testing per Specification 43 21 00 Liquid Pumps.
- G. The Contractor shall weigh the motor and pump assembly and stamp the weight on the housing in a location readily visible after installation.

END OF SECTION

SECTION 43 21 39 – DEEP WELL SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 DESCRIPTION

- A. The pumping equipment shall be furnished with all drives, pump bases, anchor bolt sleeves, and other appurtenances as specified or required for a complete installation and satisfactory operation.
- B. All work performed under this section shall be in accordance with all approved trade practices and Manufacturer's recommendations.
- C. Related Sections:
 - 1. Section 01 75 00 Testing, Training and Commissioning.
 - 2. Section 33 13 19, Disinfection of Water Supply Wells.
 - 3. Section 43 21 00, Liquid Pumps

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications:
 - 1. Manufacturer shall have a minimum of five years' experience of producing substantially similar equipment and shall be able to show evidence of at least five installations in satisfactory operation for at least five years.
- B. All equipment provided under this Section shall be obtained from a single supplier or manufacturer who, with Contractor, shall assume full responsibility for the completeness of the system. The supplier or manufacturer shall be the source of information on all equipment furnished regardless of the manufacturing source of that equipment.
- C. Unit Responsibility: Assign Unit Responsibility as specified in Section 11 05 00, Common Work Results for Equipment, to the manufacturer or supplier for the equipment specified in this Section. A Certificate of Unit Responsibility shall be provided.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 00, Submittal Procedures.
- B. Manufacturer's warranty.
- C. Manufacturer's Literature and Data

1. Pump
 - a. Manufacturer and model
 - b. Operating speed
 - c. Capacity
 - d. Characteristic performance curves
 2. Motor
 - a. Manufacturer, frame, and type
 - b. Speed
 - c. Current Characteristics and hp
 - d. Efficiency
- D. Certificate of shop test for submersible pumps. Provide certified performance curves.
- E. Certified copies of the entire factory and construction site test data sheets and reports.
- F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
1. Include complete connections which indicate all components of the system.
 2. Include complete diagrams of the internal wiring for each item of equipment.
 3. Diagrams shall have their terminals identified to facilitate installation, operation, and maintenance.
- G. Spare Parts List: Containing the required information for each pump section.
- H. Factory Test Data: Signed, dated, and certified for each pump system which requires factory testing submitted before shipment of equipment.
- I. List of all deviations from the Contract Documents.
- J. Certifications:
1. Manufacturer's certification of proper installation.
 2. Contractor's certification of satisfactory field testing.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. National Electrical Manufacturers Association (NEMA):
 - 1. ICS-6-83 Enclosures for Industrial Control and Systems, most recent revision.
 - 2. Enclosures for Electrical Equipment (1000 Volts Maximum) most recent revision.
- C. American Society of Mechanical Engineers (ASME):
 - 1. Boiler and Pressure Vessel Code: 1992 Edition with Amendments.
 - 2. Section VIII Pressure Vessels, Division I and II.
- D. Underwriters' Laboratories, Inc. (UL):
 - 1. 508-84 Electric Industrial Control Equipment most recent revision
- E. National Sanitation Foundation (NSF):
 - 1. NSF/ANSI Standard 61 - Drinking Water System Components – Health Effects
 - 2. NSF/ANSI Standard 372 - Drinking Water System Components – Lead Content

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the site to ensure uninterrupted progress of the Work. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete, in ample time to prevent delay of the Work.
- B. All boxes, crates and packages shall be inspected by Contractor upon delivery to the site. Notify Engineer if any loss or damage exists to equipment or components. Replace loss and repair damage to new condition, in accordance with manufacturer's instructions.
- C. Store materials to permit easy access for inspection and identification. Keep all material off the ground, using pallets, platforms, or other supports. Protect steel members and packaged materials from corrosion and deterioration.

PART 2 PRODUCTS

2.1 SERVICE CONDITIONS

- A. Pumps shall be submersible vertical turbine type, suitable for pumping raw groundwater.
- B. The characteristic curve of the pump shall rise from minimum head condition to shutoff without dips. The complete pumping unit consisting of the pump and respective motor shall be suitable in all respects for continuous, stable performance when operating at any point on the characteristic curve without cavitation or runout and in accordance with the vibration criteria specified herein.
- C. Each complete pumping unit, including the motor, shall be capable of safely operating at up to 125 percent of full load speed in reverse rotation without sustaining damage.
- D. Pumps shall be specially designed, constructed, and installed for the service specified and shall comply with the design conditions as specified herein.

2.2 SUBMERSIBLE PUMPS

A. General

Furnish and install submersible well pumps as shown and specified herein. The pump shall conform to ANSI/AWWA E101 for "Vertical Turbine Pumps, Lineshaft and Submersible Types", and all coatings shall be NSF 61 certified.

B. Pump Bowl Assembly

1. Bowl: The bowls shall be flanged type constructed of ductile iron conforming to ASTM A48, class 65-45-12. They shall be free from sand holes, blowholes, or other faults and must be accurately machined and fitted to close tolerances. They shall be capable of withstanding a hydrostatic pressure equal to twice the pressure at rated flow or 1.5 times shut-off head, whichever is greater. The bowls shall have enamel or epoxy lined waterways for maximum efficiency and wear protection. All intermediate bowls shall be of identical design for interchangeability. Bearings shall be Glide NSF polymer material. All assembly bolting shall be stainless steel. All wetted parts shall be coated with Tnemec, Pota Pox, or Scotchkote 134 with a total thickness of 12 mils.
2. Impeller: The impellers shall be investment cast 201, ASTM A296 and shall be enclosed type. They shall be free from defects and must be investment cast, machined, and back-filed for optimum performance and minimum vibration. Impellers shall be statically and dynamically balanced at the factory to grade G 2.5 of ISO 1940 as minimum. They shall be securely fastened to the bowl shaft with

taper locks 416 SS. The impellers shall be adjustable by means of a top shaft adjusting nut or adjustable solid shaft coupling.

3. Shaft/Bearings: The pump shaft shall be of stainless steel Grade 416 turned, ground and polished. It shall be supported by bronze bearings above and below each impeller. The motor adapter and discharge case bearing shall be grease lubricated and protected from abrasives by bronze sand collars of ASTM B584 alloy. The size of the shaft shall be no less than that determined by ANSI/AWWA Specifications E101, Section A4.3 paragraph 4.3.3. The motor coupling shall be constructed of 416 stainless steel or ductile iron either keyed or splined as required to fit the motor shaft.
4. Interconnector: The interconnector shall include a bronze sleeve bearing to protect the motor from radial loads. The interconnector shall include a suction screen constructed of corrosion resistant material.
5. Manufacturer's Nameplate: Stainless steel manufacturer's nameplates giving the manufacturer's model and serial number, rated capacity, head, speed, and all other pertinent data shall be attached to the discharge head fitting at the wellhead surface.

C. Submersible Motor

1. The motor shall be 3-phase 60 hz 480 volts, 3,600 RPM, and shall conform to NEMA specifications for submersible motors. It shall be a submersible type designed for continuous underwater operation and with a combination of a maximum water temperature and minimum velocity past the motor, such that the service factor shall be 1.0. The motor shall be compatible with operation by a variable-frequency drive.
2. Motor leads shall be of sufficient length so that they may be spliced above the bowl assembly and the leads shall be protected by a galvanized steel cable guard for the entire bowl length. The motor rating shall be selected so that the load at design is not greater than the name plate rating at 1.0 service factor and at no point on the curve shall the load exceed the name plate rating.
3. Pump motor cable shall be designed for submersible duty and shall be indicated by code or legend permanently applied to cable. Cable and sizing shall conform to National Electric Code for pump motors and shall be supplied in sufficient length to extend continuously, without splices, from the motor to the pump control panel. The power cable entry assembly shall be stainless steel and shall be provided with a strain relief element to inhibit leakage in the event the cable is pulled. Motor power cords shall meet the requirements of the Mine Safety and Health Administration for trailing cables

4. Motor thrust bearings shall be designed for continuous thrust loads under all conditions of pump operation from zero head to shut-off.

D. Power Cable

1. The power cable shall be sized such that the voltage drop will not exceed 3 percent at the motor rated full load current and voltage.
2. Cables shall be designed specifically for submersible pump service and shall consist of either single conductors individually insulated or individual conductors individually insulated and the whole covered with an outer jacket.
3. Cable Clamps:
 - a. Large Pumps: Clamps used to secure the cable to the discharge column shall be stainless steel with rubber cable protectors. Place clamps at least every 20 feet, minimum.
 - b. Small Pumps: Clamps used to secure the cable to the discharge column shall be electrical wire tie wraps or 20 mil electrical pipe wrap.
4. Cable Length: Provide as required to connect to pump control panel.
5. Cable Shield: Cable shield at pump bowls shall be of 300 series stainless steel.

E. Submersible Well Pump:

A submersible well pump shall be installed in the existing well casing according to parameters shown in the following table.

1. Performance Requirements

Design Conditions	Well 11
Design flow (gpm)	1,250
Total Dynamic Head (ft)	539
Min. Bowl Efficiency at Design (%)	75%
Maximum pump and motor speed (RPM)	3,600
Maximum Motor size (hp)	250
Static Liquid Level in Well (ft bgs*)	218
Approx Max Drawdown (ft bgs*)	450
Pump Setting* (ft bgs*)	500

*ft bgs = feet below ground surface.

2. Well Head

Well casing diameter and discharge piping diameter to be as indicated on Plans. The pump pipe diameter will be as indicated on the Plans with NPT threads.

3. Basis of Design is KSB UPA 250-250/05GB Stages.

F. Pump Columns

Pump column sections shall not exceed 21 feet in length. The pipe shall be 3/4 tapered (NPT) threaded from material conforming to ASTM A120 or ASTM A53 Grade B.

Pump columns shall include check valves. A check valve will be installed near the pump, within approximately 20 feet or one column section. Further check valves will be installed on the column at a frequency determined by the pump supplier, but not to exceed 200 feet.

G. Pump Controls

Coordinate Controls with System Integrator to ensure a properly working system. Contractor to furnish and install all required and Manufacturer's recommended controls equipment.

H. Flow Inducer Sleeve

Provide a flow inducer sleeve per Pump Manufacturer's recommendations.

2.3 SURFACE PREPARATION AND PAINTING

- A. Pumps, motors, drives, appurtenances, etc., shall receive shop primer and shop finish coating conforming to the requirements of Section 09 90 00, Painting and Coating. If any damage to the paint system occurs, the equipment shall be repainted as directed by the Engineer.
- B. Surface preparation and painting shall conform to the requirements of Section 09 90 00, Painting and Coating.
- C. All gears, bearing surfaces, machined surfaces and other surfaces which are to remain unpainted shall receive a heavy application of grease or other rust-resistant coating. This coating shall be maintained during storage and until the equipment is placed into operation.
- D. Certify, in writing, that the shop primer and shop coating system conform to the requirements of Section 09 90 00, Painting and Coating.

2.4 WATER LEVEL INDICATING & SOUNDER TUBE

- A. The pump sounding tubes shall be provided with a slotted 1.5-inch schedule 80 Flush Thread polyvinyl chloride (PVC) pipe of sufficient length to extend from the well casing soleplate to the top of the bowl assembly to serve as housing for a well pressure transducer. The conduit shall be securely fastened with Type 316 stainless steel straps to the column pipe and care shall be exercised in lowering the pump assembly so that the conduit is not damaged.

2.5 MANUFACTURER'S REPRESENTATIVE

- A. Contractor shall provide the services of the pump manufacturer's representative to certify installation and operation in accordance with Section 43 21 00, Liquid Pumps. This individual shall have a minimum of 5 years of experience working with similar well pump installations and have inspected a minimum of 50 deep well submersible pumps.

PART 3 EXECUTION

3.1 ELECTRICAL

All electrical work shall be done in conformance with Division 26 of these Specifications, and Manufacturer's recommendations.

3.2 WELL HOLE INSPECTION AND REHABILITATION

- A. Inspection: Contractor shall complete a downhole well video evaluation after the screen has been cleaned. Contractor shall use a submersible camera capable of adequately lighting the well hole and identifying any areas of concern. Contractor shall record the video, noting any areas of potential concern.
- B. Rehabilitation: Following initial video inspection, Contractor shall brush and bail the well screen with high strength bristled brushes. All turbid water shall be bailed (removed) prior to second video inspection.

3.3 INSTALLATION

- A. Install the pump, complete, at the location, grades and dimensions shown on the Plans.
- B. Work to be performed in accordance with the Manufacturer's instructions, and with the applicable regulatory requirements, including those of the Washington Department of Health.
- C. The Contractor shall prevent contamination of the water supply well. The Contractor shall have a valid Washington State Well Construction Operator's License in accordance with Chapter 173-162 WAC

- D. The Contractor shall provide the City with at least 2 working days' advance notice prior to installing the pump. All equipment shall be steam cleaned and disinfected prior to insertion in the well. The pump shall be installed to the depth directed by the City. No portion of the pump, wiring, column pipe, sounding tubes, or other fixtures shall be allowed to contact the well screen or end cap. Disposable fittings and fittings in poor condition shall be identified and replaced upon approval by the City. Equipment and fittings damaged due to Contractor error, failure of the Contractor's equipment, or improper storage shall be replaced by the Contractor at the Contractor's cost.

3.4 WELL DISINFECTION

- A. Well disinfection shall be performed per the most recent AWWA C654 *Disinfection of Wells* and WAC 173-160-371. The well shall be thoroughly cleaned of any scum, cement, oil, or other foreign substances prior to disinfecting. The quantity of chlorine compound used for disinfection shall be sufficient to produce a residual of 50 parts per million available chlorine in solution when mixed with the total volume of water in the well. The disinfectant shall be left in the well for at least 24 hours and a minimum of 1 part per million of chlorine residual shall remain in the water after 24 hours. The quantity of chlorine used shall be approved by the City. The disinfectant shall be uniformly applied throughout the entire water column, including within the screen assembly.

The Contractor shall submit a method of disinfecting the well for approval by the City.

Directly after treatment, the well shall be flushed free of chlorine and discharged. Chlorine and other disinfectants shall not be allowed to sit in the well longer than necessary. The discharge shall be treated to reduce the total chlorine residual to 0.0 mg/L at the point of discharge. The method of treatment and amount of the chemical shall be approved by the City. The Contractor shall provide chlorine monitoring equipment sensitive to 0.02 mg/L. For reference, the toxic substances criterion for total chlorine residual in freshwater is 0.02 mg/L (acute, 1-hour average per WAC 173-201A-240).

- B. Bacterial tests shall be performed by the City once turbidity is less than 0.3 NTU and the total chlorine residual is 0.0 mg/L. If the bacterial tests fail, the Contractor shall disinfect the well again at the Contractor's expense until subsequent bacterial tests pass.

To comply with procedures for bacterial sampling, the City will only take bacterial samples on days that the City laboratory will accept them, typically Monday through Thursday. Sample results are expected approximately 2 working days after the sample has been taken. Results of the bacterial tests will be shared with the Contractor within 1 working day of receipt of the results.

3.5 INSPECTION AND STARTUP

- A. Make tests under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test.
- C. The Contractor shall furnish a representative of the Manufacturer to perform inspection, start-up, and training services. The Manufacturer's representative shall be experienced in the operation and maintenance of the equipment and shall instruct the Owner's personnel in the operation and maintenance of the equipment, including step-by-step troubleshooting with necessary test equipment. The representative shall check the installation and supervise initial start-up of the equipment, and shall perform, at a minimum, the following tests on each pump:
 - Measure and record shutoff head and power draw at shutoff head.
 - Measure and record actual operating head, and power draw at actual operating flow.
 - Measure and record static head.

This service shall be provided for a minimum period of one trip and one day. After the installation and operation of the equipment has been certified, the Manufacturer's representative shall train the Owner's personnel in the proper operation and maintenance of the equipment. The Owner may videotape the training.

A start-up report, acceptable to and approved by the Engineer, shall be completed by the Manufacturer's representative before final acceptance of the pumps.

3.6 FIELD QUALITY CONTROL

- A. Provide Manufacturer's certifications verifying proper installation and operation of the pumps and pump assemblies.
- B. Replace pumps and assemblies that fail testing or are otherwise damaged at no additional cost to the Owner.

3.7 SERVICES OF PUMP MANUFACTURER

- A. As part of this construction contract, the Contractor shall utilize the full value of the Owner- acquired services for start-up and testing services from the Pump Supplier as specified in specification Section 01 75 16.

- B. An authorized service representative of the Manufacturer shall visit the Site to witness the following and to certify in writing that the equipment and controls have been properly installed, aligned, lubricated, adjusted, and readied for operation:
1. Installation of the equipment.
 2. Inspection, checking and adjusting the equipment.
 3. Startup and field testing for proper operation.
 4. Performing field adjustments to ensure that the equipment installation and operation comply with requirements.
 5. Requirements are more specifically detailed herein and in individual pump specifications.

END OF SECTION

DIVISION 46 – WATER AND WASTEWATER EQUIPMENT

**SECTION 46 20 00
MISCELLANEOUS CHEMICAL FEED EQUIPMENT**

PART 1 GENERAL

1.1 SCOPE

The Contractor shall furnish and install miscellaneous chemical feed equipment as listed below.

This section includes materials, testing, and installation of chemical feed systems for sodium fluoride and sodium hypochlorite. Components include:

- A. Skid frame to secure and contain sodium hypochlorite generator chemical feed system
- B. Metering pumps to pump each chemical from the bulk storage tank to the point of application.
- C. Interconnecting piping, located within the skid assembly for the sodium hypochlorite system.
- D. Isolation and control valves, located within the skid assembly for the sodium hypochlorite system.
- E. Pulsation dampeners, calibration columns, backpressure valves, pressure relief valves, and pressure gauges.
- F. Electrical power and control wiring and conduit between the above components
- G. Bulk chemical tanks as shown on the Plans

1.2 SUBMITTALS

- A. Submit shop drawings.
- B. Submit structural drawings showing the design of the fabricated skid. Show support systems for pumps and piping. Show materials of construction by ASTM reference and grade. Show sizes of members. Show welding, bolting, or other assembly arrangements.
- C. Submit installation and arrangement drawings showing dimensions and locations of equipment on the fabricated skid. Show locations of pumps, piping, electrical conduits and equipment, pipe and valve supports, and control panels.
- D. Submit electrical wiring drawings showing wiring and conduit, controls, interlocks, terminals, and power disconnects. Show number and sizes of power and control wiring.

Label each terminal showing which control or electrical power wire connects to each terminal.

- E. Submit operations and maintenance manuals.
- F. Submit shop drawings for the individual pieces of equipment per those equipment specifications.
- G. Submit data as a single complete package for pumps, piping, structural skid or base design, valves and actuators, motor control center components, control panels, instrument components, power and instrumentation conduits and wiring, and other items.
- H. As part of the shop drawing submittal package for the chemical feed systems, submit proposed format for reporting the results of the factory testing. Describe procedure for performing the pressure testing of the skid piping and how results (including correcting defective piping components) will be tabulated or reported. Include the format for reporting the results of factory testing for individual system components and pieces of equipment, as described in the specifications for those components or pieces of equipment.
- I. At least 30 days prior to factory testing, provide the Owner with written notification stating the schedule of the factory test so that the Owner can plan in advance to witness the testing.
- J. Submit report on results of factory testing. Do not ship systems until the Owner's Representative has reviewed the report.

1.3 MANUFACTURER AND SYSTEM RESPONSIBILITY

- A. The Contractor shall assign the design and fabrication of the chemical feed system to a single system manufacturer. Assemble the complete system on a single fabricated skid or base. Assemble and factory test as a complete system, including pumps, piping, valves, controls, and motor starters. The packaged chemical feed system manufacturer shall coordinate the skid components such as pump-to-motor couplings and motor power rating such that the system is completely integrated with compatible components.
- B. The packaged chemical system manufacturer shall determine and verify quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and the packaged chemical system manufacturer shall review and coordinate each submittal with the requirements of the contract documents.

1.4 MANUFACTURER'S SERVICES

- A. Provide three labor days to check the installation and advise during start-up, testing, and adjustment of the systems.
- B. See the individual equipment specification sections for additional labor days for manufacturer's services for the pieces of equipment.

PART 2 MATERIALS

2.1 PUMP MANUFACTURERS

ProMinent Fluid Controls, Inc., Grundfos, or equal, preapproved by the Engineer.

2.2 FABRICATED SKID OR BASE--GENERAL REQUIREMENTS

- A. Design skid or base and the associated supports and anchor bolts to support the equipment per CBC, Section 1613 and ASCE 7, Chapter 15:
- B. Provide a common drip or drain pan having a minimum depth of 2 inches under all the pumps to collect leakage. Construct pan of 3/8-inch-thick (minimum) HDPE or 3/8-inch thick (minimum) FRP. Resin shall be Ashland Derakane 411 or 470, Reichhold Dion 9800, or Ashland Hetron 922. The pan shall extend under the pumps and tanks so that any leakage is contained within the skid or base. Slope the pan at least 1:20 toward a single side of the skid, where a drain opening of at least 1/2 inch shall be provided to effect drainage. Pipe joints and pipe flange faces, including pump suction and discharge connections, shall be within the drain pan or drain collection area.
- C. Provide the skid or base with four lifting lugs, one at each corner, designed to lift the weight of the complete skid or base with all equipment attached to it. Alternatively, provide the base with cutouts, designed to lift the weight of the complete skid or base with equipment attached to it, for forklift tongs or cables.
- D. Provide a design such that each pump is individually bolted to a baseplate. A single common baseplate, or individual pump baseplates, may be provided, but each pump shall be individually bolted so that it is removable.
- E. Each pump shall be removable by disconnecting only the piping connected to its inlet and outlet connections. It shall not be necessary to disconnect or remove any adjacent piping or electrical conduit or wiring in order to remove or replace any pump.

2.3 FABRICATED THERMOPLASTIC OR FRP SKID OR BASE

- A. Skid or base shall be fabricated with FRP. Use a combination of wide flange members, C-channels, hollow structural fiberglass tubing, and plates or sheets to construct the

skid or base. Minimum plate, sheet, or member thickness shall be 1/2 inch. Provide reinforcing gussets inside the superstructure, beneath the deck, to provide increased stiffness.

- B. Alternatively, fabricate skid and base using thermally welded PVC or high-density polyethylene plastic. Use plates or sheets to construct the skid or base. Minimum plate, sheet, or member thickness shall be 5/8 inch. Provide reinforcing gussets, as needed, beneath the deck to provide increased stiffness. Plates shall be heat welded to form permanent continuous bond. Design and construct skid such that the thermoplastic structural members and sheet material are supported so that the skid does not bend or sag. Thermoplastic welding shall conform to the applicable ASTM standards for the material used. Welds shall have a smooth and uniform finish.
- C. Fasteners for skids in chemical service other than sodium hypochlorite shall be stainless steel and shall comply with ASTM A193, Grade B8M or ASTM F593, Type 316. Nuts shall be ASTM A194, Grade 8M or ASTM F594, Type 316. Use ASTM A194 nuts with ASTM A193 bolts; use ASTM F594 nuts with ASTM F593 bolts. Provide washer for each nut and bolt head. Washers shall be of the same material as the nuts.
- D. Fasteners for skids in sodium hypochlorite service shall be titanium. Bolts shall be titanium, in accordance with ASTM F468, Grade Ti1, Ti2, or Ti7. Nuts shall conform to ASTM F467, same material as the bolts. Alternatively, use FRP fasteners or FRP encapsulated steel fasteners.

2.4 STORAGE TANKS

- A. Tanks shall be translucent HDPE with level indicators. Manufacturer must guarantee compatibility of tank for long term storage of the intended chemical, and tanks must be NSF/ANSI 61 approved for use with drinking water systems.
- B. Tanks shall open from the top and this top opening shall remain accessible for refilling chemical tanks. Tanks must be capable of fully closing when not in use.
- C. Storage tanks include:
 - 1. Sodium hypochlorite storage tank
 - 2. Brine storage tank
 - 3. Sodium fluoride
- D. The 30-55 gallon storage tanks for sodium fluoride shall be Stenner STS30N-02 or approved equal. If proposed tank does not include a pump mount connection, Contractor shall propose alternate tank mounting to be pre-approved by the Engineer.

2.5 METERING PUMPS

See Section 46 30 00.

2.6 ISOLATION AND PRESSURE-RELIEF VALVES WITHIN THE SKID OR BASE

Piping Service	Valve Type
Sodium fluoride Sodium Hypochlorite	Double Union CPVC Ball Valves

- A. Provide Double Union CPVC Ball Valves: Isolation valves shall be vented CPVC ball valves, 3 inches and smaller, for chemical service shall be rated at a pressure of 150 psi at a temperature of 105°F and rated at a pressure of 85 psi at a temperature of 140°F. Provide machined vent hole, deburred, in the ball to allow gases to vent. Body, ball, and stem shall be CPVC conforming to ASTM D1784, Type 4, Grade 1. Seats shall be Teflon. O-ring seals shall be Viton. Valve ends shall be of the union design with two-way blocking capability. Ends shall be socket welded except where threaded or flanged-end valves are specifically shown in the drawings. Valves shall have handle for manual operation. Valves shall be Plast-O-Matic “Z-MBV-Vent,” Asahi/America Type 21, or equal.
- B. Provide pressure-relief and backpressure valves in discharge piping of metering pumps.
- C. Provide an isolation valve on the suction and discharge piping of each pump. Provide an isolation valve for each calibration column. Provide an isolation valve for each drain/flush connection.

2.7 PULSATION DAMPENERS

Provide a pulsation dampener on the discharge piping of the metering pumps. The pulsation dampener shall be of the appendage type having a gas-charged bladder in a pressure vessel. Dampener shall be a pressure vessel per the ASME Pressure Vessel Code, Section VIII. Sizing shall result in no more than ±5% variation in average pressure in the discharge line. Variation shall be checked and confirmed on pressure gauge installed upstream of discharge dampener. Mount a gas charging valve and liquid-filled pressure gauge on each dampener. Pulsation dampeners shall be Greer Bladder Accumulator, Pulsafeeder Pulsatrol, Blacoh, or equal.

2.8 CALIBRATION TUBE

- A. Provide a clear calibration tube in the piping between the metering pumps and the suction inlet. Provide isolation valve between the tube and the piping.
- B. Calibration cylinder and fittings shall be made of inert clear PVC, shall have a cap, and have calibration marks. Provide at least 10 calibration lines, with a minimum of one line every 100 mL. Provide columns with NPT or PVC union connections at the bottom and also the top for vent pipe connection.
- C. Capacities shall allow for a 1-minute test.

2.9 MISC EQUIPMENT

- A. Approximately 80 feet of 2" Schedule 80 PVC tubing with threaded fittings to vent chlorine tank outside wall of building, total for both WTPs. Provide casing through wall.
- B. Approximately 65 feet of 2" Schedule 80 PVC tubing with long sweep radius bends for under slab chemical containment conduit (see drawings), total for both WTPs.
- C. All non-metallic piping, tubing and fittings on sodium hypochlorite system as shown on the drawings.
- D. All non-metallic piping, tubing and fittings on permanganate feed system as shown on drawings.
- E. All non-metallic piping, tubing and fittings on phosphoric acid feed system as shown on drawings.
- F. Injectors can be mounted on double strap saddles with $\frac{3}{4}$ " tap.
- G. Cam lock fittings for chlorine fill lines, one per treatment plant.
- H. Chemical feed tubing shall be $\frac{3}{8}$ " OD x $\frac{1}{4}$ " ID tubing for chlorine and permanganate suction and feed lines. Tubing shall be rated for max. of 200 PSI and chemically resistant. Tubing shall be encased in conduit as shown on drawings.

2.10 WIRING AND CONDUIT WITHIN THE SKID OR BASE

- A. Power wiring for 120-volt circuits shall be No. 12 AWG with No. 12 AWG ground. Install wiring per the NEC.
- B. Color-code control wiring in switching and control assemblies per ICEA Method 1, NEC applications, Option A. Jacket shall be black PVC. Lay out conductors neatly so they may be followed by eye from one terminal to another. Wiring shall be vertical or horizontal. Color-coding shall be such that electrically common interconnections of devices are the same color. The colors may be used more than once but not in the same circuit or cable grouping.
- C. Power and control cable shall be copper, insulated for 600 volts, 75°C wet and 90°C dry locations, UL Type THWN or XHHW, and shall comply with UL 83. Insulation jacket shall be nylon. Install bare or green insulated copper conductors in power circuits for grounding connections.

2.11 FACTORY TESTING

- A. Each chemical feed system shall be subjected to a non-witnessed factory performance test. Test each package system by using water. Provide a separate water supply test

tank and operate the control system by simulating the external control signals. Verify that the control system automatically controls the packaged system in response to the specified external control signals. Verify that metering pumps respond to the external flow-pacing signals.

- B. Verify that the various specified alarm signals are generated and transmitted from the system control panel. Simulate metering pump running, flow switch activation, and high and low pressure alarms.
- C. Pressure test skid piping (except for overflow and vent piping) to a pressure of 150 psi for duration of 2 hours. There shall be no leakage at any pipe joint or connection to any valve or piece of equipment. Repair or replace any defective pipe joint or connection and retest.

PART 3 EXECUTION

3.1 ASSEMBLING SKID OR BASE

- A. Assemble and mount components on the fabricated skid or base at the factory. Provide a 4 inch minimum clearance between pipes and around equipment.
- B. Design skid to provide access to the manual stroke control knobs located with the metering pumps.
- C. Design skid to provide clearance for and access to the automatic stroke positioners located with the metering pumps.
- D. The front of the skid shall be clear of any piping or conduits to allow for maintenance access to the skid components.

3.2 ASSEMBLING SKID PIPING AND ELECTRICAL CONDUIT

- A. Provide separate supports for pulsation dampener and calibration tube. Do not mount unsupported devices directly on the piping.
- B. Provide fiberglass with Type 316 stainless steel fasteners and hardware for the piping. Provide a support for each pipe at its termination point at the edge of the skid, within 3 inches of any isolation valve.
- C. Route electrical conduit around the ends and sides of the skid or base. Do not install conduit overhead. Install wiring on the skid or base in aluminum rigid conduit with a minimum size of 3/4 inch. Install power and control wiring in separate conduits. Terminate conduits at the control panel.
- D. Do not run any conduit or piping beneath the drain pan.

3.3 ASSEMBLING AND MOUNTING TANK-MOUNTED PUMPS

- A. Pump shall be mounted to the chemical tank with the manufacturer provided mounting plate. Ensure compatibility between tank mounting and the pump mounting plate.
 - 1. If proposed tank does not allow for tank-mounting of pumps, submit relevant pump mounting information and equipment to Engineer for pre-approval. Pump shall be mounted above the respective chemical tank, no higher than 5 feet above floor level. Provide a 4 inch minimum clearance between pipes and around equipment.
- B. Mount pump in such a way to provide access to the manual stroke control knobs located with the metering pumps.
- C. Mount pump in such a way to provide clearance for and access to the automatic stroke positioners located with the metering pumps.

3.4 ASSEMBLING PIPING AND ELECTRICAL CONDUIT FOR TANK-MOUNTED PUMPS

- A. Do not mount unsupported devices directly on the piping.
- B. Route electrical wiring around the ends and sides of the pump and tank. Do not install wiring or conduit overhead.

3.5 ISOLATION VALVE LOCATIONS

Provide isolation valves at the following points:

- A. Inlet connection to each pump.
- B. Outlet connection from each pump.

3.6 PRESSURE-RELIEF VALVE LOCATIONS

Provide pressure-relief valve on the discharge piping of each metering pump. Size valve to match the associated metering pump capacity.

3.7 PIPE TERMINATIONS

Locate connections to skid drain pan, metering pump suction and discharge piping as shown on the plans.

3.8 FIELD TESTING

- A. Test each package system by using the actual chemical for the system. The Contractor shall provide sufficient chemical for a test period as specified in the General Conditions (Volume 1). Fill each tank and operate the control system. Verify that the control system automatically controls the packaged system in response to the specified

external control signals. Verify that metering pumps respond to the external flow-pacing signal.

- B. Verify that the various specified alarm signals are generated and transmitted from the system control panel. Verify metering pump running, tank overflow, tank high and low alarm levels, drain pan liquid level, flow switch activation, and high and low pressure alarms.

END OF SECTION

**SECTION 46 30 00
CHEMICAL FEED PUMPS**

PART 1 GENERAL

1.1 SCOPE

The Contractor shall furnish and install a chemical feed skid with two chlorine feed pumps with capacities as shown below. The contractor shall also furnish and install a chemical feed pump for sodium fluoride with the capacity shown below. Miscellaneous fittings shall also be provided as listed. The electronic metering pump shall be drive capable of accepting a 4-20mA signal from a pump control unit supplied by the same manufacturer as the pump supplier and shall include accessories as noted below.

1.2 PRESUBMITTALS FOR BIDDING APPROVAL

If products other than the listed acceptable product are to qualify for bidding, the following prebid submittals are required.

- A. Exceptions to these specifications along with justification for each exception.
- B. Manufacturer and type designation.
- C. Catalog and/or specification data confirming conformance to specified design, material, and equipment requirements.
- D. Installation requirements.
- E. Operation and maintenance information per the General Conditions (Volume 1).

1.3 SUBMITTALS FOR CONSTRUCTION

- A. Submit shop drawings in accordance with the General Conditions (Volume 1).
- B. Submit dimensional drawings.
- C. Submit manufacturer's catalog data and detail drawings showing metering pump parts and describe by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type. Show stroke speed at the specified flow. Show linings and coatings. Identify each metering pump by tag number to which the catalog data and detail sheets pertain.
- D. Submit proof of NSF 61 certification for the metering pumps when pumping the chemical listed in the Service Conditions.

1.4 MANUFACTURER'S SERVICES

- A. Provide equipment manufacturer's services at the jobsite for the minimum labor days listed below, travel time excluded:
- B. Three labor days to check the installation and advise during start-up, testing, and adjustment of the equipment.

PART 2 MATERIALS

2.1 MANUFACTURERS

The electronic-actuated diaphragm metering pump shall be the Grundfos DDA, ProMinent Delta, or equal, preapproved by the Engineer.

2.2 PUMP DESIGN AND CONSTRUCTION

- A. The diaphragm-metering pump shall be an electronic pulsing or solenoid driven, positive displacement, disc or tubular diaphragm pump. Pump materials of construction are designated in the subsection on "Service Conditions."
- B. Provide the pump with a dial knob for manual stroke length adjustment. The stroke adjustment system shall allow 0% to 100% of full stroke length while the pump is operating.
- C. Provide the pump with a separate dial knob for stroke frequency adjustment (10% to 100% of the maximum strokes per minute).
- D. The metering pump drive shall be totally enclosed with no exposed moving parts. The solid-state electronic pulser shall be fully encapsulated with no exposed printed circuit etch and be supplied with quick connect terminals at least 3/16 inch (4.75 mm) wide. Electronics shall be housed in a chemical-resistant enclosure at the rear of the pump for maximum protection against chemical spillage.
- E. Pressure-relief bypass shall automatically release chemical to pump suction when discharge pressure exceeds the value specified in the subsection on "Service Conditions." Alternatively, provide a design in which the pump ceases its stroking action when the backpressure exceeds the strength of the magnetic force developed by the power coil.
- F. The pump housing shall be of chemical-resistant glass-fiber reinforced thermoplastic.
- G. Metering pump valves shall be ball type, with balls seating on combination valve seat and seal ring. Valve seat and seal rings shall be renewable by replacing only the combination seat-seal ring.

2.3 POWER SUPPLY

Power supply shall be 120 volts, single phase, 60 hertz.

2.4 SUCTION AND DISCONNECTIONS

The suction and discharge connections shall accept polyethylene tubing via compression connections.

2.5 EXTERNAL INTERFACE SIGNALS

- A. Provide interface to accept a remote start/stop signal to the metering pump in the remote mode.
- B. Provide a remote status indication of "pump running" with an isolated contact closure, rated for 5 amperes at 120-volt ac.
- C. Provide a remote status indication of local/remote switch position with an isolated contact closure, rated for 5 amperes at 120-volt ac.
- D. Provide a percent of speed with 4- to 20-mA d-c output corresponding to 0% to 100% speed for remote indication of metering pump pump.
- E. Provide a 4- to 20-mA input signal for stroke speed control.

2.6 LIQUIDS PUMPED

Liquids pumped are described below. See the subsection on "Service Conditions" to determine which pumps handle the particular liquids described.

- A. Sodium Hypochlorite (0.7% ± 0.05 solution)

Specific gravity	1.0 to 1.2
Viscosity	1 centipoise
Temperature	45°F to 120°F

- B. Sodium Fluoride (4%)

Specific gravity	1.39
pH	5-8
Viscosity	1 to 60 centipoise
Temperature	45°F to 120°F

2.7 SPARE PARTS

- A. 1 spare pump of the same make/model as the Sodium Fluoride pump.
- B. Provide the following spare parts for each pump:

Quantity	Item
1	Diaphragm
2	Ball check valve assemblies
1	Seat and seal ring assembly

- C. Pack spare parts in a wooden box; label with the job location, pump type and model, manufacturer’s name and local representative’s name, address, and telephone number and attach list of materials contained within.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

Provide the manufacturer’s recommended lubricants for each piece of equipment.

3.2 SERVICE CONDITIONS

- A. Pump hydraulic performance conditions and design data shall be as shown below.
- B. Sodium Hypochlorite Pump Tag Numbers: WTR22MP_01, WTR22MP_02, WTR12MP_01, WTR12MP_02

Location	Hypochlorite Storage Area
Liquid pumped	Sodium Hypochlorite
Capacity range	9- 18 gph
Maximum design discharge pressure	150 psig
Pressure-relief valve setting	165 psig
Maximum required suction lift	0 feet
Remote run/stop signal required?	Yes
Remote status indication of pump running required?	Yes
Remote status indication of local/remote operation required?	Yes
4- to 20-mA output signal for remote indication of pump speed required?	Yes

Location	Hypochlorite Storage Area
4- to 20-mA input signal for remote control of pump speed required?	Yes
Toggle switch for selecting internal manual stroke frequency/external remote signal?	Yes
Pump ball check valve construction	Ceramic
Seat and seal ring construction	PTFE
Pump head construction	PVDF
Fittings and connections at pump head	PVDF
Diaphragm construction	PTFE
Manufacturer and model	Grundfos DDA 120-7
Number of Pumps	2

C. Sodium Fluoride Pump Tag Numbers: WTR22MP_03, WTR12MP_03

Location	Sodium Fluoride storage area
Liquid pumped	Sodium Fluoride
Capacity range	0.1 – 0.6 gph
Maximum design discharge pressure	150 psig
Pressure-relief valve setting	165 psig
Maximum required suction lift	0 feet
Remote run/stop signal required?	Yes
Remote status indication of pump running required?	Yes
Remote status indication of local/remote operation required?	Yes
4- to 20-mA output signal for remote indication of pump speed required?	Yes
4- to 20-mA input signal for remote control of pump speed required?	Yes
Toggle switch for selecting internal manual stroke frequency/external remote signal?	Yes
Pump ball check valve construction	Ceramic
Seat and seal ring construction	PTFE
Pump head construction	PVDF
Fittings and connections at pump head	PVDF
Diaphragm construction	PTFE
Manufacturer and model	Grundfos DDA 7.5-16
Number of Pumps	1

3.3 FIELD TESTING

Operate each pump, using the fluid they are to normally pump, for eight consecutive hours during which time no repairs shall be required. Assure that manual stroke length and frequency adjustments on the pumps perform over the specified adjustment range. Assure that diaphragms do not leak or tear. Repair or replace any leaking diaphragms. Assure that backpressure and pressure-relief valves have been provided and set as specified. Repair or replace any valves not set or operating as specified.

END OF SECTION

**SECTION 46 33 13
ON-SITE ELECTROLYTIC HYPOCHLORITE GENERATION SYSTEM**

PART 1 GENERAL

1.1 SUMMARY

A. Scope

1. The disinfection system shall consist of an on-site sodium hypochlorite generating system.
2. Production of the sodium hypochlorite solution shall be automatic and on-demand, utilizing solar grade salt, water, and electrical power to produce a <1.0% hypochlorite solution.
3. Capacity shall be 40-pounds of equivalent chlorine per day.
4. The sodium hypochlorite production system shall be a complete system including the electrolyzer cells, DC power supply, brine delivery system, and process controller mounted in an enclosed cabinet manufactured by Evoqua Water Technologies.
5. The on-site generating system manufacturer shall be the manufacturer of the anodes supplied with the electrolyzer(s).
6. In order to simplify spares, service, and quality control requirements, the complete disinfection system shall be manufactured and provided by the same manufacturer as the production unit.
7. The on-site generator manufacturer must be able to document a minimum of 1,000 electro-chlorination installations worldwide.
8. The hypochlorite generation skid shall be OSEC[®] L as manufactured by Evoqua Water Technologies / Wallace & Tiernan

PART 2 PRODUCTS

2.1 GENERATOR ASSEMBLY

- A. Two electrolyzer assemblies with a capacity of 20-pounds of equivalent chlorine per day as <1.0% sodium hypochlorite solution each, totaling to 40-pounds per day.
- B. Cathodes and Anodes shall be manufactured from Titanium. Anodes shall be DSA type with precious metal oxide coating on a titanium substrate. Electrodes shall be

manufactured by the manufacturer of the OSHG system to ensure the electrodes are suitable quality and meet performance specifications.

- C. Electrolyzer shall consist of vertically oriented bi-polar electrodes.
- D. The bi-polar electrolyzer assembly shall consist of a minimum of one cell compartment mounted in a horizontal electrolyzer.
- E. Each electrolyzer compartment shall allow hydrogen removal to facilitate two-phase flow pattern. Hydrogen gas removal shall be vertical, while the electrolyte solution flow path shall be horizontal.
- F. Multiple electrolyzer configurations shall utilize a modular approach. Each electrolyzer shall be added or removed in parallel to expand or reduce the total capacity as desired.
- G. Each electrolyzer shall be capable of running independently with a dedicated power supply.
- H. Hydrogen gas lift within each electrolyzer shall not exceed 3 inches vertically.
- I. Power usage shall not exceed 2.2 to 2.5 KWH AC per pound of equivalent chlorine at a concentration of 0.7%.
- J. Electrolyzer shall be able to meet the stated efficiencies operating with an inlet water temperature range of 41-86°F.
- K. Electrolyte solution sample and drain valves shall be included.
- L. Level switch and temperature switch shall be externally mounted to the hypochlorite outlet manifold to enable maintenance without intrusion to the electrolyzer assembly.
- M. Electrolyzer assembly shall be pre-piped and mounted within the system cabinet. The cabinet assembly shall be wall mounted and have a footprint that does not exceed 29" wide x 46" high x 15" deep per electrolyzer.

2.2 PROCESS CONTROLLER

- A. The entire generation process shall be controlled by a Wallace & Tiernan microprocessor complete with a capacitive-touch, 4.3" colored glass touch screen for easy and intuitive operation.
- B. Enclosure shall be NEMA 4X, IP66.
- C. Input voltage shall be 100-240 VAC, 1 phase, 50/60 Hz.
- D. Control voltage shall be 24 VDC

- E. Controller shall be CE/CSA Listed.
- F. Operation and alarm readouts shall indicate system status. Status indicators to include:
 - 1. Audible alarm contacts
 - 2. Power on
 - 3. DC Power supply on
 - 4. Blower running
 - 5. Brine pump on
 - 6. Analog storage tank level transmitter
 - 7. DC Power supply failed
 - 8. Improper voltage
 - 9. Improper amps
 - 10. High electrolyte solution temperature
 - 11. Low electrolyzer solution level
 - 12. Overflow of storage tank
 - 13. Low storage tank level
 - 14. Air flow failed, blower failed
 - 15. External interlock for emergency shut down
 - 16. External interlock for hydrogen detection
- G. The following shall be provided as freely configurable volt-free outputs:
 - 1. General Fault
 - 2. Dosing pump enable
 - 3. Audible Alarm
 - 4. Rectifier On/Off
 - 5. Hydrogen leak alarm (if used)

- H. The Following Panel sourced AC voltage outputs shall be provided.
 - 1. Brine Pump/Water Valve On/Off
 - 2. Blower On/Off
- I. The process controller shall be programmed and configured for the following discrete inputs:
 - 1. Electrolyte Level switch (pre-wired from generator)
 - 2. Electrolyte Temperature switch (wired from generator)
 - 3. Rectifier Running (wired from power supply)
 - 4. Improper voltage (wired from power supply)
 - 5. Improper amps (wired from power supply)
 - 6. Blower air flow switch (field wired from transmitter)
- J. The process controller shall be programmed, and panel configure for the following Analog Inputs:
 - 1. Tank Level Transmitter
 - 2. Rectifier output voltage
 - 3. Rectifier output current
 - 4. Electrolyte outlet temperature
- K. Intrinsic barriers shall be provided for the following supplied generator equipment.
 - 1. Electrolyte Level Switch
 - 2. Electrolyzer Outlet temperature switch

2.3 DC POWER SUPPLY

- A. Power for the electrolysis of brine shall be provided by a high efficient dual mode constant voltage and constant current output power supply. The on-site generation system shall consist of 4 power supplies running in parallel to a dedicated electrolyzer cartridge.
- B. Input power shall be 100-240 VAC \pm 10% single phase at 50/60 Hz. Output to be constant current 32A and 15V DC.

- C. Power supply enclosure shall be rated to meet IP67/IP65 certifications suitable for indoor and outdoor operation.
- D. Power supply shall have automatic output overload protection.
- E. Power supply shall be built to CE/CSA standards.
- F. The power supplies shall be mounted in the on-site generation cabinet.
- G. Power supply shall be Mean Well HLG-600H series with no exception.

2.4 BRINE PUMP

- A. Brine pump shall be peristaltic type controlled via the supply voltage from the on-site generation system power control system.
- B. The brine pump shall be sized to deliver flows of 1 gph (4 L/hr).
- C. Brine and water shall be combined within the system cabinet piping.
- D. Water flow shall be established through a solenoid valve and controlled with a flow control purge meter.
- E. The system shall function to deliver a 3% brine solution to the electrolyzers during periods of operation.
- F. The brine pump shall be a Chem-Ad® VPP-DC.

2.5 SATURATOR

- A. Saturator shall be high-density polyethylene. Usable storage capacity shall be 200 gallons.
- B. The saturator shall include an automatic level control system to maintain a constant liquid brine level.
- C. Saturator shall be designed for storage of brine solution at ambient temperature and atmospheric pressure and shall be suitable for indoor/outdoor installation.

2.6 HYPOCHLORITE STORAGE TANK

- A. Hypochlorite storage/hydrogen dilution tank, totally enclosed, with flanged drain, overflow, inlet and outlet connections, with air dilution inlet and outlet connections and blower suitably sized to dilute hydrogen to at least 25% below LEL.
- B. The following controls shall be included:

1. Ultrasonic level transmitter control with 4-20 mA output for start-stop operation of the system; FM and CSA Intrinsically Safe; Wetted material shall be suitable for 1.0% hypochlorite solution.
 2. User-adjustable alarms:
 - a) Overflow (optional)
 - b) High storage level
 - c) System stop
 - d) System Start
 - e) Low storage level and metering pump disable
- C. Storage capacity: 1000 gallons.

2.7 WATER SOFTENER

- A. If the incoming water exceeds 17 mg/l in calcium hardness, a water softener will be provided to eliminate potential fouling of the electrodes, which impairs the efficiency of the electrolysis process.
- B. Softener shall be dual tank design with automatic change-over for regeneration, suitably sized for the system water requirements.

2.8 HYDROGEN DILUTION BLOWER

- A. Blower shall be provided to force ventilate the product tank reducing the concentration of Hydrogen gas in the tank and discharged from the system vent to below 25% of LEL, which is 1% in air.
- B. Air flow or blower failure shall automatically shut down the process controller.
- C. Fail safe air flow switch contacts shall be incorporated to ensure safe operation.
- D. On system shut down, the blower must remain active for a 15 minute duration.

2.9 HYDROGEN-IN-AIR DETECTOR & ALARM (Optional)

- A. Hydrogen detecting system shall continuously monitor the on-site hypochlorite equipment area for the presence of hydrogen gas in the ambient atmosphere.
- B. The system shall be a remote electrochemical sensor type consisting of sensor/transmitter and receiver.

- C. The gas detector shall be ranged for 0 to 4% gas concentration and shall have two independent alarm set points adjustable for 5% to 100% of range, with separate alarm LEDs and an integral audible alarm horn.
- D. LED readout of gas concentration in percent and a 4-20 mA proportional output signal shall also be available.

2.10 ANALYTICAL TITRATION KIT

- A. A titration kit to measure the product concentration and brine concentration shall be furnished with the OSEC system.

PART 3 EXECUTION

3.1 START UP AND TRAINING

- A. One full day of training shall be provided on-site to the operation staff after the equipment start-up.

3.2 SERVICE

- A. Factory trained direct or authorized service contractor shall be available within 24 hours of notification.

3.3 WARRANTY

- A. System shall be warranted for 12 months from date of start-up.
- B. Electrolyzer(s) shall be warranted for 24 months from date of start-up.

END OF SECTION

SECTION 46 33 14

SELF-CONTAINED FLUORIDE UPFLOW SATURATOR AND FEED SYSTEM

PART 1 GENERAL

1.01 DESCRIPTION

A. SCOPE

1. This section specifies requirements for self-contained Fluoride Upflow Saturator and Feed Systems, including requirements for system construction, materials, functional testing, quality and use.
2. The manufacturer shall furnish all materials, equipment and incidentals required to install self-contained fluoride feed system as shown on the drawings and specified herein.
3. The entire system shall consist of the following major components:
 - 1) Upflow Fluoride Saturator Tank
 - 2) Sodium Fluoride Metering Pump
 - 3) Metering Pump Calibration Column
 - 4) Water Feed System
 - 5) System Control Panel

B. SYSTEM DESCRIPTION

1. The self-contained fluoride feed system shall consist of an upflow fluoride saturator tank, a chemical metering pump, metering pump calibration column, a water feed system, and control panel. The feed system provides equipment to safely produce the sodium fluoride solution and inject the solution into the water stream by means of a metering pump in a controlled fashion as required by the process conditions. A local control panel shall be provided to ensure proper control and operation of the system.
2. System shall be designed for the following operating conditions:

No.	Max. Well Flow Rate, gpm	Max. Well Pump Discharge Pressure,	Existing Fluoride Conc. (mg/L)	Required Fluoride Conc. (mg/L)	Sodium Fluoride Solution Feed Rate,	Max. Metering Pump Capacity, gpH	Max. Metering Pump Discharge Pressure,
-----	--------------------------	------------------------------------	--------------------------------	--------------------------------	-------------------------------------	----------------------------------	----------------------------------------

		psig			gPH		psig
1	1,250	100	0.0	0.7	2.7	5.28	145

1.02 QUALITY ASSURANCE

A. MANUFACTURER REQUIREMENTS

1. All equipment provided under this section shall be obtained from a single manufacturer, who shall:
 - 1) Assume full responsibility for the completeness and proper operation of the fluoride upflow saturator and feed system.
 - 2) Have experience, be reputable and qualified in designing and manufacturing completely packaged and self-contained fluoride upflow saturator and feed system equipment of the identical type and size specified for a minimum of 5 years.
 - 3) Supply units containing all necessary appurtenances and components for a complete and operating system conforming to this specification. The entire system shall be pre-assembled, piped, wired, factory tested and shipped as a single unit. Loose components shall not be acceptable. System footprint as shown on the drawings shall not be exceeded.
 - 4) Have at least ten identical completely packaged and self-contained fluoride upflow saturator and feed systems in operation for at least five years.
2. To ensure quality and complete unit responsibility, the complete system must be assembled and tested by the manufacturer at its facility and be a standard and regularly marketed product of that manufacturer. The manufacturer must have a physical plant, technical and design staff, and fabricating personnel to complete the work specified.
3. The owner reserves the right to be present at the fabricator’s facility for visual inspection of equipment to be supplied and to witness factory functional testing.

B. SPECIFIED MANUFACTURERS

1. LMI
2. Integrity Municipal Systems LLC
3. Or approved equal.

C. WARRANTY

1. The manufacturer shall warrantee that the equipment provided shall be free of defects in material and workmanship for a period of 12 months from beneficial occupancy. The warranty period shall not extend beyond 18 months from delivery of the system to the jobsite.

D. PRODUCT SUBMITTALS

1. The following product data shall be submitted by the fluoride feed system manufacturer for review and approval by the engineer prior to the fabrication of the system:

- 1) Process and instrumentation diagram for system
- 2) Process and system sizing calculations specific to the required parameters per this specification
- 3) Scaled drawing of general arrangement and major system components
- 4) Material safety and data sheets (MSDS) for sodium fluoride
- 5) Major system component information and descriptive literature for the following:
 - a) Fluoride solution metering pump
 - b) Saturator tank
 - c) System controls and control panel including power and control wiring diagrams, terminals, and numbers
 - d) Miscellaneous instrumentation and accessories
 - 6) Installation instructions
 - 7) Reference(s) for at least five identical units that have been installed and have been operational for at least three years of continuous service.

E. OPERATION AND MAINTENANCE MANUALS

1) Detailed operation and maintenance (O&M) manual for the system shall be provided by the manufacturer. A total of two (2) copies of O&M manuals are required.

F. MANUFACTURER SERVICES

1. The system manufacturer representative shall be present at the jobsite for the following time period after the system is installed, travel time excluded:

- 1) Eight (8) hours for system startup, functional testing, and certification of proper installation.
- 2) Eight (8) hours for operator training for overall operation, maintenance and troubleshooting for the system.
- 3) Provide one trip for 2 days for tasks 1 and 2 above.

PART 2 – PRODUCTS

2.01 SELF-CONTAINED FLUORIDE UPFLOW SATURATOR AND FEED SYSTEM UNIT

Saturator, metering pump, water feed system, electrical control, and all other required appurtenances shall be assembled in a completely self-contained, fluoride saturator and feed system package. Components of the saturator and feed system shall comply with this specification. The entire system shall be pre-assembled, piped, wired, factory tested and shipped as a single unit. Loose components shall not be acceptable.

2.02 SATURATOR TANK

A. Tanks shall be made from linear polyethylene with a wall thickness of ¼". Tanks shall

have visible calibration marks.

- B. Tanks shall each have a capacity of 55 gallons.
- C. Tanks shall be distributed by Ryan Herco Products, model P/N 7110.011 or approved equal.
- D. Tanks shall have a hinged top distributed by Ryan Herco Products, model P/N 7122.011, or approved equal. Hinges shall be of the flexible polyfin hinge type.

2.03 CHEMICAL METERING PUMP

- A. The chemical metering pump shall be provided to deliver 4% sodium fluoride solution.
- B. The chemical metering pump shall have a maximum capacity of 5.28 gph.
- C. The chemical metering pump shall be a microprocessor-controlled, simplex, solenoid-driven reciprocating, and mechanically-actuated diaphragm type pump. All pumping functions shall be set by membrane-switch keypad and displayed on a legible, illuminated-LCD display. Keypad will allow for simple scrolling and display of programmed parameters. The housing shall be rated NEMA 4X.
- D. The power supply shall be 120 VAC, 60 Hz, single phase. The microprocessor is to automatically compensate for supply voltage variations within 15% of the rated voltage such that the frequency of the pump remains constant.
- E. The liquid end shall be physically separated from the drive unit by a back plate with weep hole creating an air gap. An elastomer shaft wiper seal shall prevent contamination of the solenoid if the primary diaphragm fails. The diaphragm shall be constructed of a steel core, vulcanized into nylon-reinforced EPDM, with PTFE faced fluid contact surface.
- F. The pump shall utilize technology whereby the time sequence of the dosing flow can be exactly matched to the requirements of the application.
- G. The pump shall have technology integrated into the drive to detect blocked metering points or broken metering lines, and to detect airlocks within the delivery unit.
- H. The liquid end shall be constructed of PVDF with Teflon seals with a built-in coarse valve and needle valve for air bleed, manually adjusted for continuous degassing of process fluid and self-priming against pressure. The suction and discharge valves shall be of the double ball check design for discharge pressures greater than 100 psi.
- I. Programming and Control:
 - 1. Stroke length control shall have manual adjustment capability between 0% and 100% with a stroke adjustment knob on the pump face control; The LCD shall

digitally display stroke length setting in 1% increments in the full range between 0% and 100%.

2. Programming shall allow pump to be calibrated so as to display pump output in gallons/hour. Calibration shall be maintained when stroke length is altered up to plus or minus 10% on the stroke length knob. If stroke length is altered by more than 10%, a yellow warning will light and a flashing message "calib" will appear.
3. Keypad shall allow for scrolling and shall display parameters such as stroke frequency, stroke length, stroke counter, pump output in gph, dosing quantity, mA current input being received by pump, and indication of external mode.
4. Stroke frequency control shall be manually adjusted by touch keypads, with the set stroke rate displayed on the LCD.
5. The pump shall accept an analog signal such that stroke frequency is proportional to 4-20mA. The pump shall allow the setting of a maximum stroke rate which corresponds to the maximum analog signal, with stroke rate proportional to signal strength below that rate. Analog to digital converters external to the pump shall not be allowed.

J. The metering pump shall have ANSI/NSF-61 certification.

K. ACCESSORIES

1. Back Pressure Valve – Back Pressure Valve shall be ½-inch socket ends and constructed of PVC body with PTFE diaphragm. Back pressure valve shall be field adjustable from 15 to 150 PSI. Initial factory setting shall be 50 PSI.
2. Control Cable – 15-Foot Control cable will be supplied.
3. Wall Mount Bracket shall be supplied.

2.04 SATURATOR WATER FEED SYSTEM AND APPURTENANCES

A. **Soft water** is required to be provided to the saturator. Water flow rate to be 1 gpm at 30 psig. Contractor to regulate incoming pressure to 30 psig.

B. The water feed system shall include the following:

1. Clear filter housing
2. Water feed NSF 61 solenoid valve
3. Flow control needle valve
4. Backflow/Anti-siphon valve
5. Water Flow Rotameter
6. All piping shall be SCH 80 PVC.

C. The sodium fluoride solution tank shall be equipped with an ultrasonic level switch for automatic control of the saturator operation. Ultrasonic level switch shall be Flowline Echopod DS 14-00.

2.05 SURFACE MOUNTED SOLUTION TANK MIXER

1. A general purpose mixer shall be installed in the solution tank.
2. The mixer operation shall be controlled by level switch in the solution tank and by an adjustable timer.
3. Surface mounted solution tank mixer shall meet the following terms:
 - Motor: 1/20 HP, 115V/60Hz/ 1 phase TEFC
 - Shaft: 316 stainless steel shaft
 - SS Impeller: 316 stainless steel fabricated to shaft

2.06 ELECTRICAL CONTROL PANEL

- A. The electrical control panel shall provide electrical control for the entire system including metering pump, saturator water feed control, level switches, and alarms.
- B. The control panel enclosure shall be rated NEMA 4X. The panel shall be mounted on the system skid and factory pre-wired to system components.
- C. The panel shall have the following components or functionality:
 1. "Power On" white indicator light
 2. "On-Off" switch for system
 3. "System On" green indicator light
 4. "Hand-Off-Auto" switch for chemical metering pump
 5. "Fluoride Pump On" green indicator light
 6. "Containment Level High" red indicator light
 7. "Common Fault" red indicator light
 8. Timer control for mixer
 9. A high-level switch and alarm shall be provided for secondary containment to shut off the system in case of level detection.
10. Solution tank shall be provided with an ultrasonic level switch to turn the saturator operation on and off.
- D. The power supply shall be 110V, 1 ph, 60 Hz, 15 Amps.

PART 3 - EXECUTION

3.01 FACTORY ASSEMBLY AND TESTING

- A. Each system shall be pre-assembled at the manufacturing location.
- B. System(s) shall be tested at the location of assembly to assure they are in full operational and working order per the requirements of the specific design(s) for the project and this specification.
- C. Factory testing shall include visual inspection of all equipment, complete assembly and functional testing of equipment including tank hydrotest, piping and instrumentation check, verification of control panel wiring and operation.

3.02 DELIVERY AND INSTALLATION

A. System(s) shall be packaged and shipped so as not to incur damage to any portion of the unit through handling and installation of the unit itself.

B. System(s) shall be installed per the manufacturer's guidelines and recommendations.

3.03 FIELD START-UP

A. A factory representative from manufacturer shall be present at the jobsite for initial system start-up and commissioning of equipment as specified in section 1.02.F. Factory representative will ensure that system is properly installed, will start-up the system and train owner's personnel.

3.04 SODIUM FLUORIDE

A. Initial fill of sodium fluoride crystals shall be provided by the contractor.

3.05 IDENTIFICATION AND MARKING

A. The self-contained fluoride upflow saturator and feed system, along with applicable components shall be marked and identified for all health, flammability, and reactivity of hazardous materials as required by all applicable jurisdictional building codes, statutes, standards, regulations and laws.

END OF SECTION

APPENDIX A
GEOTECHNICAL REPORT

Geotechnical Engineering Services

McCormick Woods Well 11 Site Improvements
Port Orchard, Washington

for
Murraysmith, Inc.

November 22, 2021



Geotechnical Engineering Services

McCormick Woods Well 11 Site Improvements
Port Orchard, Washington

for

Murraysmith, Inc.

November 22, 2021



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Geotechnical Engineering Services

McCormick Woods Well 11 Site Improvements Port Orchard, Washington

File No. 12309-018-00

November 22, 2021

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Appendix A. Well 11 Geologic Log

Appendix B. Subsurface Explorations and Laboratory Testing

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Figures B-2 and B-3 – Log of Borings

Figure B-4 – Sieve Analysis Results

Appendix C. Report Limitations and Guidelines for Use

1.0 INTRODUCTION

This report provides a summary of soil and groundwater conditions and geotechnical design recommendations for the City of Port Orchard (City) McCormick Woods Well 11 Site Improvements Project. The project site is located at an existing City well site, west of the Strathmore Circle SW and St. Andrews Drive SW intersection in Port Orchard, Washington. A Vicinity Map is provided as Figure 1. Our understanding of the project is based on our discussions with you and review of the 10 percent design package prepared by Murraysmith, dated May, 2021. We prepared a Preliminary Geotechnical Engineering Services Report dated July 30, 2020 to support development of the 10 percent design package.

We understand that Well 11 was drilled and constructed in 2011. This project will improve and replace existing infrastructure around the site. We understand that the project will include construction of a monitoring well house around the Well 11 well head, construction of a new booster pump station, installation of new generators, and modifications to or installation of new yard piping and utilities. As part of the project the existing water reservoir tanks at the site will be demolished, decommissioned or repurposed. The proposed structures at the site will likely be constructed using concrete masonry units (CMUs). We expect that relatively minor grading activities will occur as part of the project to establish design grades, construct new access roadways and install associated utilities. We assume that stormwater facilities, if included in the project, will be designed in accordance with the 2014 Department of Ecology Stormwater Management Manual for Western Washington (SWMMWW), which has been adopted by the City.

2.0 PURPOSE AND SCOPE OF SERVICES

The purpose of our services is to explore subsurface conditions at the site as a basis for providing geotechnical design and construction recommendations for the project. Our services have been provided in accordance with our signed agreement for this project executed on August 17, 2021. Our proposal dated March 30, 2020 outlines our specific scope of services. GeoEngineers is also providing permitting services for this project. These services will be provided as separate deliverable(s).

3.0 SITE CONDITIONS

3.1. Surface Conditions

The project site is located in the McCormick Woods neighborhood or Port Orchard, and is bordered by residential developments to the north and east, St. Andrews Drive and the McCormick Woods Golf Club to the south and a City maintenance facility to the west. The project site is accessed via a gated gravel road from St. Andrews Drive. The project site is generally flat with grade changes typically on the order of 2 feet or less. The parcel has an irregular shape and is developed with existing single-story pump house buildings, two concrete 60,000-gallon water reservoirs, and other supporting infrastructure. We understand that there are four well heads at the site including Well 11 and the older McCormick Wells. The access roads at the site are paved with gravel, and sod covers portions of undeveloped areas of the site. Trees around the site include coniferous trees as large as about 30 to 36 inches in diameter at breast height.

3.2. Subsurface Conditions

3.2.1. Literature Review

Based on our review the Preliminary Geomorphic Map of the Kitsap Peninsula (Haugerud 2009) the project site is underlain by glacial till. Glacial till is typically comprised of an unsorted mixture of sand, gravel, cobbles and boulders in a silt matrix. Glacial till was deposited below the base of advancing and retreating glaciers and is highly over consolidated. Glacial till deposits are typically dense to very dense, however, the upper few feet of the deposit can be weathered and less dense than the underlying intact glacial till.

We reviewed the Well 11 Construction and Testing Report prepared by Robinson Noble, which includes a summary geologic log for Well 11. We have included this summary well log as Appendix A. The drilling for Well 11 extended about 1,080 feet below ground surface (bgs). A detailed description of the geology encountered during drilling of Well 11 is provided in the Robinson Noble report. The soils described on the Well 11 geologic log within about 50 feet of the ground surface included “Brown-Gray Claybound Gravel,” “Brown-Gray Claybound Sand and Gravel,” and “Brown-Gray Claybound Gravel and Sand.” These soil descriptions are consistent with glacial till. Indications of soil density or drilling resistance are not included on the geologic log.

3.2.2. Subsurface Explorations and Laboratory Testing

We explored subsurface conditions at the site by advancing two borings at the approximate locations shown on the Site Plan, Figure 2. The borings were extended to nominal depths of about 50.5 feet bgs. Summary exploration logs are provided in Appendix B. Selected samples from the borings were tested in our laboratory to evaluate pertinent engineering properties. A summary of the laboratory testing program and the test results are provided in Appendix B.

3.2.3. Soil and Groundwater Conditions

Based on the conditions observed in our explorations, soil conditions at the site consist of two primary soil units: fill and glacially consolidated soils. Fill was observed below the sod in B-2, extending to around 2 feet bgs. Fill consisted of medium dense silty sand with gravel. We did not observe what we interpret to be fill in B-1. We expect that fill thickness will vary across the site and will be thicker in areas surrounding existing improvements or where prior grading activities have occurred.

Below the fill in B-2, and starting below the sod in B-1 we observed what we interpret to be glacially consolidated soils. Glacially consolidated soils typically consisted of dense to very dense silty sand with gravel, sand with silt and gravel and hard sandy silt. These soils were visually consistent with glacial till type soils. Our borings were terminated within the glacially consolidated soil around 50.5 feet bgs.

We did not observe what we interpret to be the regional groundwater table in our explorations. We observed perched groundwater in B-2 around 25 feet bgs. We expect that areas of perched groundwater could be encountered throughout the soil profile. Perched water tends to accumulate at contacts between geologic units, where soil types change or within seams of predominantly sand and gravel soils. We expect that areas of perched groundwater will be seasonal, isolated and discontinuous across the site.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1. Site Class and Seismic Considerations

We anticipate that seismic design will be performed in accordance with 2018 International Building Code (IBC) Standards. Based on soil conditions observed in our borings we recommend that Site Class C be used for design. The following parameters provided in Table 1 should be used for design.

TABLE 1. SEISMIC DESIGN PARAMETERS

2018 IBC Seismic Design Parameters	
Spectral Response Acceleration at Short Periods (S_s)	1.631g
Spectral Response Acceleration at 1-Second Periods (S_1)	0.567g
Site Class	C
Site Modified Peak Ground Acceleration (PGA)	0.693g
Design Spectral Response Acceleration at Short Periods (SD_s)	1.304g
Design Spectral Response Acceleration at 1-Second Periods (SD_1)	0.542g

Based on the soil conditions observed in our borings and our understanding of the site geology, in our opinion there is a low risk of liquefaction, lateral spreading, or surface fault rupture occurring at this site.

4.2. Foundation Support

In our opinion the proposed structures can be adequately supported on conventional shallow foundations. We recommend that structures bear on intact glacially consolidated soils or on proof compacted existing fill soils. Exterior footings should be established at least 18 inches below the lowest adjacent grade. Interior footings can be founded a minimum of 12 inches below the top of the floor slab. Isolated column and continuous wall footings should have minimum widths of 24 and 18 inches, respectively.

The sections below provide our recommendations for foundation bearing surface preparation and foundation design parameters.

4.2.1. Foundation Bearing Surface Preparation

Shallow foundation excavations should be performed using a smooth-edged bucket to limit bearing disturbance. We recommend that the base of all footing excavations be proof compacted to a uniformly firm and unyielding condition prior to placement of structural fill, formwork or rebar. Loose or disturbed materials present at the base of footing excavations should be removed or compacted. If soft or otherwise unsuitable areas are observed at the base of the overexcavation that cannot be compacted to a stable and uniformly firm condition the following options may be considered: (1) the exposed soils may be moisture conditioned and recompacted; or (2) the unsuitable soils may be overexcavated and replaced with compacted structural fill, as needed.

Foundation bearing surfaces should not be exposed to standing water. If water is present in the excavation, it must be removed before placing structural fill, formwork and reinforcing steel. Protection of exposed soil should be considered during the wetter times of the year. The amount of protection will depend, in part, on

prevailing weather, soil type exposed, and duration exposed. Typically, a 3- to 4-inch lean concrete mat or a 6-inch crushed rock section is suitable for foundation bearing surface protection.

Prepared foundation bearing surfaces should be observed and evaluated by a member of our firm prior to placement of structural fill, formwork or steel reinforcement. Our representative will confirm that the bearing surfaces have been prepared in accordance with our recommendations and is suitable for supporting the design footing load and provide recommendations for remediation, if necessary.

4.2.2. Allowable Soil Bearing Resistance

Shallow foundations bearing on subgrades prepared as recommended may be designed using an allowable soil bearing pressure of 4,000 pounds per square foot (psf). This bearing pressure applies to the total of dead and long-term live loads and may be increased by one-third when considering total loads, including earthquake or wind loads. These are net bearing pressures. The weight of the footing and overlying backfill can be ignored in calculating footing sizes.

4.2.3. Settlement

Disturbed soil must be removed from the base of footing excavations and the bearing surface should be prepared as recommended. Provided these measures are taken, we estimate the total static settlement of shallow foundations will be on the order of 1 inch or less for the bearing pressures presented above. Differential settlements could be on the order of $\frac{1}{4}$ to $\frac{1}{2}$ inch between comparably loaded isolated column footings or along 50 feet of continuous footing. Settlement is expected to occur rapidly as loads are applied. Settlements could be greater than estimated if loose or disturbed soil is present beneath footings.

4.2.4. Lateral Resistance

The ability of the soil to resist lateral loads is a function of frictional resistance, which can develop on the base of footings and slabs and the passive resistance, which can develop on the face of below-grade elements of the structure as these elements tend to move into the soil. The allowable frictional resistance on the base of the footing may be computed using a coefficient of friction of 0.40 applied to the vertical dead-load forces. The allowable passive resistance on the face of the footing or other embedded foundation elements may be computed using an equivalent fluid density of 325 pounds per cubic foot (pcf) for undisturbed site soils or structural fill extending out from the face of the foundation element a distance at least equal to two and one-half times the depth of the element. These values include a factor of safety of about 1.5.

The passive earth pressure and friction components may be combined, provided that the passive component does not exceed two-thirds of the total. The passive earth pressure value is based on the assumptions that the adjacent grade is level and that groundwater remains below the base of the footing throughout the year. The top foot of soil should be neglected when calculating passive lateral earth pressure unless the area adjacent to the foundation is covered with pavement or a slab-on-grade.

4.2.5. Slab-on-Grade Floors

We expect that slab subgrade soils will be comprised of structural fill, existing fill material or glacial till, and all are satisfactory provided the subgrade can be prepared as recommended. The exposed subgrade should be evaluated after site grading is complete. Disturbed areas should be compacted, if possible, or removed and replaced with compacted structural fill. In all cases, the exposed soil should be firm and unyielding. It

may be appropriate to compact the exposed subgrade with a smooth drum vibratory roller to a dense and unyielding condition.

We recommend slab-on-grade floors be underlain by a minimum 6-inch-thick capillary break consisting of clean sand and gravel, crushed rock or washed rock with less than 3 percent fines. Material similar to Washington State Department of Transportation (WSDOT) Standard Specification 9-03.1(4)C Grading No. 67 is a suitable material for use as capillary break.

Provided that loose soil is removed and the subgrade is prepared as recommended, we recommend slabs-on-grade be designed using a modulus of subgrade reaction of 300 pounds per cubic inch (pci). We estimate that settlement for slabs-on-grade constructed as recommended will be less than $\frac{3}{4}$ inch for a floor load of 500 psf.

4.2.6. Footing and Below-Slab Drainage

In our opinion footing and below slab drains are not necessary to maintain foundation bearing support at this site. However, because the native soils at the site have a relatively low permeability there is a potential for surface water pooling around and below structures. If dry conditions must be maintained within the proposed structures, we recommend that a perimeter foundation drainage system be considered. If included, perimeter drains should be provided with cleanouts and should consist of at least 4-inch-diameter perforated pipe surrounded on all sides by 6 inches of drain material enclosed in a non-woven geotextile fabric for underground drainage to prevent fine soil from migrating into the drain material. We recommend that the drainpipe consist of either heavy-wall solid pipe or rigid corrugated smooth interior polyethylene pipe. We do not recommend using flexible tubing for footing drainpipes. The drain material should consist of pea gravel or material similar to "Gravel Backfill for Drains" per WSDOT Standard Specifications Section 9-03.12(4). The perimeter drains should be sloped to drain by gravity, if practical, to a suitable discharge point. Water collected in roof downspout lines must not be routed to the perimeter footing drains.

4.3. Earth Pressures for Conventional Retaining Walls and Below-Grade Structures

4.3.1. Design Parameters

We recommend the following lateral earth pressures be used for design of conventional retaining walls and below-grade structures. Our design pressures assume that the ground surface around the retaining structures will be level or near level. If drained design parameters are used, drainage systems must be included in the design in accordance with the recommendations presented in section "4.3.2 Drainage" below.

- Active soil pressure may be estimated using an equivalent fluid density of 35 pcf for the drained condition.
- Active soil pressure may be estimated using an equivalent fluid density of 85 pcf for the undrained condition; this value includes hydrostatic pressures.
- At-rest soil pressure may be estimated using an equivalent fluid density of 55 pcf for the drained condition.
- At-rest soil pressure may be estimated using an equivalent fluid density of 95 pcf for the undrained condition; this value includes hydrostatic pressures.

- For seismic considerations, a uniform lateral pressure of $10H$ psf (where H is the height of the retaining structure or the depth of a structure below ground surface) should be added to the lateral earth pressure.
- An additional 2 feet of fill representing a typical traffic surcharge of 250 psf should be included if vehicles are allowed to operate within $\frac{1}{2}$ the height of the retaining walls. Other surcharge loads should be considered on a case-by-case basis. We can provide additional surcharge loads for specific loading conditions once known.

The active soil pressure condition assumes the wall is free to move laterally $0.001 H$, where H is the wall height). The at-rest condition is applicable where walls are restrained from movement. The above-recommended lateral soil pressures do not include surcharge loads other than those described, or the effects of sloping backfill surfaces. We should be consulted if other surcharge loads are anticipated or if sloping backfill conditions are planned, as this will change the lateral earth pressures provided.

Over-compaction of fill placed directly behind retaining walls or below-grade structures must be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet of retaining walls and below-grade structures.

Retaining wall foundation bearing surfaces should be prepared following Section “4.2 Foundation Support” of this report. Provided bearing surfaces are prepared as recommended retaining wall foundations may be designed using the allowable soil bearing values and lateral resistance values presented above. We estimate settlement of retaining structures will be similar to the values previously presented for building foundations.

4.3.2. Drainage

If retaining walls or below-grade structures are designed using drained parameters, a drainage system behind the structure must be constructed to collect water and prevent the buildup of hydrostatic pressure against the structure. We recommend the drainage system include a zone of free-draining backfill a minimum of 18 inches in width against the back of the wall. The drainage material should consist of coarse sand and gravel containing less than 5 percent fines based on the fraction of material passing the $\frac{3}{4}$ -inch sieve. Material similar to “Gravel Backfill for Drains” per WSDOT Standard Specifications Section 9-03.12(4) is also suitable. Waffle board-type drainage mats may be considered instead of gravel provided they are protected from accumulating silt and discharge appropriately.

A perforated, rigid, smooth-walled drainpipe with a minimum diameter of 4 inches should be placed along the base of the structure within the free-draining backfill and extend for the entire wall length. The drain pipe should be metal or rigid PVC pipe and be sloped to drain by gravity. Discharge should be routed to appropriate discharge areas and designed to reduce erosion potential. Cleanouts should be provided to allow routine maintenance. We recommend roof downspouts or other types of drainage systems not be connected to retaining wall drain systems.

4.4. Stormwater Infiltration

We assume that stormwater facilities at the site, if planned, will be designed in accordance with the 2014 SWMMWW. The fill and glacial till soils at the site have a low to very low infiltration potential due to the high percentage of fine silt and clay-sized particles and the highly over consolidated nature of the material.

Stormwater infiltration is still, in our opinion, feasible, however facilities will likely need to be designed for very low infiltration rates. Additional field infiltration testing will be completed as part of a final design. The sections below provide an estimate of soil infiltration rate based on soil grain size and our experience.

4.4.1. Preliminary Infiltration Rate Estimate

To provide an initial and preliminary estimate of infiltration rates for the site soils, we used the Soil Grain Size Analysis Method presented in the SWMMWW. The Soil Grain Size Analysis Method is an empirical correlation between soil gradation and infiltration rate. This method typically does not account for other factors that influence in-situ infiltration rate such as relative density, degree of weathering, soil layering, and groundwater conditions. As such, our design values presented are preliminary and further study would be needed if a final design rate is required.

Based on our experience designing infiltration facilities in the area and the results of the Soil Grain Size Analysis Method, we recommend that infiltration facilities be evaluated assuming an infiltration rate of 0.1 inch per hour. This is a the “long-term” saturated infiltration rates, which includes the appropriate reduction factors recommended in the SWMM.

4.4.2. Recommendations for Additional Studies

If design of infiltration facilities are included at this site, additional testing, analysis, and reporting may be required to establish the final design infiltration rate. The SWMMWW requires that for glacially consolidated soils, the long-term design infiltration rate be determined via a pilot infiltration test (PIT). Where infiltration facilities are considered, we recommend that at least one PIT should be performed at each proposed location. The location of the PIT should be near (ideally within) the footprint of the proposed infiltration facilities. We can assist with performing PITs, and associated analysis and reporting, if necessary.

4.5. Pavement Design

Based on our experience, we provide recommended conventional asphalt concrete pavement (ACP) sections for the site. These pavement sections may not be adequate for heavy construction traffic loads such as those imposed by concrete transit mixers, dump trucks or cranes. Additional pavement thickness may be necessary to prevent pavement damage during construction or if other loading types are planned. The recommended sections assume that final improvements surrounding the conventional ACP will be designed and constructed such that stormwater or excess irrigation water from landscape areas does not accumulate below the pavement section or pond on pavement surfaces.

Pavement subgrade should be prepared as recommended in section “4.6.7 Subgrade Preparation” and should be evaluated by a member of our firm during construction. Areas of deleterious materials, organics, or otherwise unsuitable soils may need to be removed from below pavements. Crushed surfacing base course and subbase should be moisture conditioned to near optimum moisture content and compacted to at least 95 percent of maximum dry density (MDD) as determined by ASTM International (ASTM) Test Method D 1557.

Crushed surfacing base course should conform to applicable sections of 4-04 and 9-03.9(3) of the WSDOT Standard Specifications. Hot mix asphalt should conform to applicable sections of 5-04, 9-02, and 9-03 of the WSDOT Standard Specifications.

4.5.1. Standard-Duty ACP – Automobiles and Light Trucks

- Two inches of hot mix asphalt, class ½ inch, PG 58-22
- Four inches of crushed surfacing base course
- Native subgrade or structural fill prepared as recommended

4.5.2. Heavy-Duty ACP – Areas Subject to Heavy-Duty Traffic

- Three inches of hot mix asphalt, class ½ inch, PG 58-22
- Six inches of crushed surfacing base course
- Native soil or structural fill prepared as recommended

4.6. Site Development and Earthwork

We anticipate that site development and earthwork will include demolition of existing features, excavating for shallow foundations, utilities and other improvements, establishing subgrades for structures and hardscaping, and placing and compacting fill and backfill materials. We expect that site grading and earthwork can be accomplished with conventional earthmoving equipment. The following sections provide specific recommendations for site development and earthwork.

4.6.1. Clearing, Stripping and Demolition

Clearing and stripping depths will likely be on the order of 2 to 3 inches in areas currently surfaced with sod or other gravel surfacing. Greater stripping depths could be required within structural areas or areas of denser vegetation. Stripped grass and sod material must not be re-used as fill.

While not observed in our borings, coarse gravel cobbles and boulders could be present in the glacially consolidated soils at the site. Accordingly, the contractor should be prepared to remove boulders and cobbles, if encountered during grading or excavation. Boulders may be removed from the site or used in landscape areas. Voids caused by boulder removal should be backfilled with structural fill.

We recommend that foundations and floor slabs of existing structures be completely removed from areas that will be redeveloped.

4.6.2. Erosion and Sedimentation Control

Erosion and sedimentation rates and quantities can be influenced by construction methods, slope length and gradient, amount of soil exposed and/or disturbed, soil type, construction sequencing and weather. Implementing an Erosion and Sedimentation Control Plan will reduce the project impact on erosion-prone areas. The plan should be designed in accordance with applicable city, county and/or state standards. The plan should incorporate basic planning principles, including:

- Scheduling grading and construction to reduce soil exposure;
- Re-vegetating or mulching denuded areas;
- Directing runoff away from exposed soils;
- Reducing the length and steepness of slopes with exposed soils;

- Decreasing runoff velocities;
- Preparing drainage ways and outlets to handle concentrated or increased runoff;
- Confining sediment to the project site; and
- Inspecting and maintaining control measures frequently.

Some sloughing and raveling of exposed or disturbed soil on slopes should be expected. We recommend that disturbed soil be restored promptly so that surface runoff does not become channeled.

Temporary erosion protection should be used and maintained in areas with exposed or disturbed soils to help reduce erosion and reduce transport of sediment to adjacent areas and receiving waters. Permanent erosion protection should be provided by paving, structure construction or landscape planting.

Until the permanent erosion protection is established, and the site is stabilized, site monitoring may be required by qualified personnel to evaluate the effectiveness of the erosion control measures and to repair and/or modify them as appropriate. Provisions for modifications to the erosion control system based on monitoring observations should be included in the Erosion and Sedimentation Control Plan.

4.6.3. Temporary Excavation

Excavations deeper than 4 feet must be shored or laid back at a stable slope if workers are required to enter. Shoring and temporary slope inclinations must conform to the provisions of Title 296 Washington Administrative Code (WAC), Part N, "Excavation, Trenching and Shoring." Regardless of the soil type encountered in the excavation, shoring, trench boxes or sloped sidewalls will be required under Washington Industrial Safety and Health Act (WISHA). The contract documents should specify that the contractor is responsible for selecting excavation and dewatering methods, monitoring the excavations for safety and providing shoring, as required, to protect personnel and structures.

In general, temporary cut slopes at this site should be inclined no steeper than about 1½H to 1V (horizontal to vertical). This guideline assumes that all surface loads are kept at a minimum distance of at least one-half the depth of the cut away from the top of the slope and that seepage is not present on the slope face. Flatter cut slopes will be necessary where seepage occurs or if surcharge loads are anticipated. Temporary covering with heavy plastic sheeting should be used to protect slopes during periods of wet weather.

4.6.4. Permanent Slopes

If permanent slopes are necessary, we recommend they be constructed at a maximum inclination of 2H:1V. Where 2H:1V permanent slopes are not feasible, protective facings and/or retaining structures should be considered.

To achieve uniform compaction, we recommend that fill slopes be overbuilt slightly and subsequently cut back to expose well-compacted fill. Fill placement on slopes steeper than about 5H:1V should be benched into the slope face. The configuration of benches depends on the equipment being used. Bench excavations should be level and extend into the slope face.

Exposed areas should be re-vegetated as soon as practical to reduce the surface erosion and sloughing. Temporary protection should be used until permanent protection is established.

4.6.5. Groundwater Handling Considerations

Based on our understanding of the proposed site improvements, we do not anticipate that the regional groundwater table will be encountered in excavations at the site.

We recommend that the contractor performing the work be prepared to encounter perched groundwater seepage in excavations at the site. The interface between the fill material and native soils and contacts between relatively more permeable and relatively less permeable materials are likely locations for accumulation of perched groundwater. Groundwater seepage handling needs will typically be lower during the late summer and early fall months. We anticipate that shallow perched groundwater, if encountered, can be handled adequately with sumps, pumps, and/or diversion ditches, as necessary. Ultimately, we recommend that the contractor performing the work be made responsible for controlling and collecting groundwater encountered.

4.6.6. Surface Drainage

Surface water from roofs, pavements and landscape areas should be collected and controlled. Curbs or other appropriate measures such as sloping pavements, sidewalks and landscape areas should be used to direct surface flow away from buildings, erosion sensitive areas and from behind retaining structures. Roof and catchment drains should not be connected to wall or foundation drains.

4.6.7. Subgrade Preparation

Subgrades that will support slab-on-grade floors, pavements, or other structural elements should be thoroughly compacted to a uniformly firm and unyielding condition on completion of stripping/excavation and before placing structural fill. We recommend that subgrades for structures, pavements and other bearing surfaces be evaluated, as appropriate, to identify areas of yielding or soft soil. Probing with a steel probe rod or proof-rolling with a heavy piece of wheeled construction equipment are appropriate methods of evaluation.

If soft or otherwise unsuitable subgrade areas are revealed during evaluation that cannot be compacted to a stable and uniformly firm condition, we recommend that: (1) the unsuitable soils be scarified (e.g., with a ripper or farmer's disc), aerated and recompacted, if practical; or (2) the unsuitable soils be removed and replaced with compacted structural fill, as needed.

4.6.8. Subgrade Protection and Wet Weather Considerations

The wet weather season generally begins in October and continues through May in Western Washington; however, periods of wet weather can occur during any month of the year. The soils encountered in our explorations contain a significant amount of fines. Soil with high fines content is very sensitive to small changes in moisture and is susceptible to disturbance from construction traffic when wet or if earthwork is performed during wet weather. If wet weather earthwork is unavoidable, we recommend that the following steps be taken.

- The ground surface in and around the work area should be sloped so that surface water is directed away from the work area. The ground surface should be graded so that areas of ponded water do not develop. Measures should be taken by the contractor to prevent surface water from collecting in excavations and trenches. Measures should be implemented to remove surface water from the work area.

- Earthwork activities should not take place during periods of heavy precipitation.
- Slopes with exposed soils should be covered with plastic sheeting.
- The contractor should take necessary measures to prevent on-site soils and other soils to be used as fill from becoming wet or unstable. These measures may include the use of plastic sheeting and controlling surface water with ditches, sumps with pumps and by grading. The site soils should not be left uncompacted and exposed to moisture. Sealing the exposed soils by rolling with a smooth-drum roller prior to periods of precipitation will help reduce the extent to which these soils become wet or unstable.
- Construction traffic should be restricted to specific areas of the site, preferably areas that are surfaced with working pad materials not susceptible to wet weather disturbance.
- Construction activities should be scheduled so that the length of time that soils are left exposed to moisture is reduced to the extent practical.
- During periods of wet weather, concrete should be placed as soon as practical after preparation of the footing excavations. Foundation bearing surfaces should not be exposed to standing water. If water pools in the base of the excavation, it should be removed before placing structural fill or reinforcing steel.
- If foundation excavations are exposed to extended wet weather conditions, a lean concrete mat or a layer of clean crushed rock can be considered for foundation bearing surface protection.

4.7. Fill Materials

4.7.1. Structural Fill

The workability of material for use as structural fill will depend on the gradation and moisture content of the soil. We recommend that washed crushed rock or select granular fill, as described below, be used for structural fill during the rainy season. If prolonged dry weather prevails during the earthwork phase of construction, materials with a somewhat higher fines content may be acceptable. Weather, material use, schedule, duration exposed, and site conditions should be considered when determining the type of import fill materials purchased and brought to the site for use as structural fill.

Material used for structural fill should be free of debris, organic contaminants and rock fragments larger than 6 inches. For most applications, we recommend that structural fill material consist of material similar to “Select Borrow” or “Gravel Borrow” as described in Section 9-03.14 of the WSDOT Standard Specifications.

4.7.2. Select Granular Fill/Wet Weather Fill

Select granular fill should consist of well-graded sand and gravel or crushed rock with a maximum particle size of 6 inches and less than 5 percent fines by weight based on the minus $\frac{3}{4}$ -inch fraction. Organic matter, debris or other deleterious material should not be present. In our opinion, material with gradation characteristics similar to WSDOT Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing), “Gravel Backfill for Walls” as described in Section 9-03.12(2) of the WSDOT Standard Specifications, or 9-03.14 (Borrow) is suitable for use as select granular fill, provided that the fines content is less than 5 percent (based on the minus $\frac{3}{4}$ -inch fraction) and the maximum particle size is 6 inches.

4.7.3. Pipe Bedding

Trench backfill for the bedding and pipe zone should consist of well-graded granular material similar to “gravel backfill for pipe zone bedding” described in Section 9-03.12(3) of the WSDOT Standard Specifications. The material must be free of roots, debris, organic matter and other deleterious material. Other materials may be appropriate depending on manufacturer specifications and/or local jurisdiction requirements.

4.7.4. Trench Backfill

Trench backfill must be free of debris, organic material and rock fragments larger than 6 inches. We recommend that import trench backfill material consist of material similar to “Select Borrow” or “Gravel Borrow” as described in Section 9-03.14 of the WSDOT Standard Specifications. Where water is present, alternative materials may need to be considered.

4.7.5. Gravel Backfill For Walls

Backfill material used within 5 feet behind retaining walls should consist of free-draining material similar to “Gravel Backfill for Walls” as described in Section 9-03.12(2) of the WSDOT Standard Specifications.

4.7.6. Capillary Break Material

Structural fill placed as capillary break material below on-grade floor slabs should consist of ¾-inch coarse aggregate with negligible sand or silt as described in Section 9-03.1(4)C Grading No. 67 of the WSDOT Standard Specifications. WSDOT Specification 9-03.9 (Aggregates for Ballast and Crushed Surfacing, Crushed Surfacing Base Course [CSBC]) may also be considered.

4.7.7. Recycled Materials

Recycled asphalt and concrete can be considered for use as structural fill provided that material meets the gradation requirements for its intended use. Recycled materials should not be used as capillary break material, in drainage applications, within infiltration facilities, or in areas where groundwater flow may occur. Crushed asphalt has the potential to creep under large and sustained loads. Accordingly, we recommend that crushed/recycled asphalt not be used under foundation elements or below slab on grade. Crushed asphalt can be considered for use below pavements.

4.7.8. On-Site Soil

Based on our subsurface explorations and experience, it is our opinion that existing site soils including the existing fill may be considered for use as structural fill and trench backfill, provided they can be adequately moisture conditioned, placed and compacted as recommended and do not contain organic or other deleterious material. The fill and native glacially consolidated soils at the site are primarily comprised of silty sand and are extremely moisture sensitive. These soils will be very difficult or impossible to properly compact when wet and we do not recommend they be reused as structural fill during periods of wet weather. In addition, it is possible that existing soils will be at moisture contents above what is optimum for compaction when they are removed from excavations. In this case, the soils would need to be moisture conditioned prior to re-use. Space for drying out material during dryer weather or covering on-site materials generated during wet weather should be considered. During wetter or even slightly colder times of year, such as when temperatures get below about 60 degrees, accommodations to cover stockpiled material generated on site that will be used as structural fill should be planned.

If earthwork occurs during a typical wet season, or if the soils are persistently wet and cannot be dried back due to prevailing wet weather conditions, we recommend the use of imported select granular fill, as described above.

4.8. Fill Placement and Compaction

To obtain proper compaction, fill soil should be compacted near optimum moisture content and in uniform horizontal lifts. Lift thickness and compaction procedures will depend on the moisture content and gradation characteristics of the soil and the type of equipment used. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Generally, 12-inch loose lifts are appropriate for steel-drum vibratory roller compaction equipment. Compaction should be achieved by mechanical means. During fill and backfill placement, sufficient testing of in-place density should be conducted by a representative of GeoEngineers to check that adequate compaction is being achieved.

4.8.1.1. Area Fills and Pavement Bases

Fill placed to raise site grades and materials under pavements and structural areas should be placed on subgrades prepared as previously recommended. Fill material placed below structures and footings should be compacted to at least 95 percent of the theoretical MDD per ASTM International (ASTM) D 1557. Fill material placed shallower than 2 feet below pavement sections should be compacted to at least 95 percent of the MDD. Fill placed deeper than 2 feet below pavement sections should be compacted to at least 90 percent of the MDD. Fill material placed in landscaping areas should be compacted to a firm condition that will support construction equipment, as necessary, typically around 85 to 90 percent of the MDD.

4.8.1.2. Backfill Behind Below-Grade Structures

Backfill behind retaining walls or below-grade structures should be compacted to between 90 and 92 percent of the MDD. Overcompaction of fill placed directly behind below-grade structures should be avoided. We recommend use of hand-operated compaction equipment and maximum 6-inch loose lift thickness when compacting fill within about 5 feet behind below-grade structures.

4.8.1.3. Trench Backfill

For utility excavations, we recommend that the initial lift of fill over the pipe be thick enough to reduce the potential for damage during compaction, but generally should not be greater than about 18 inches above the pipe. In addition, rock fragments greater than about 1 inch in maximum dimension should be excluded from this lift.

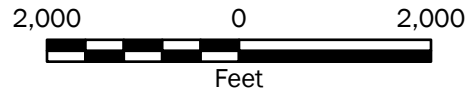
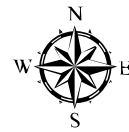
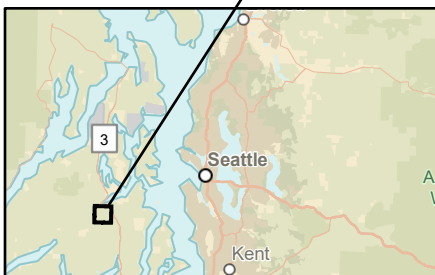
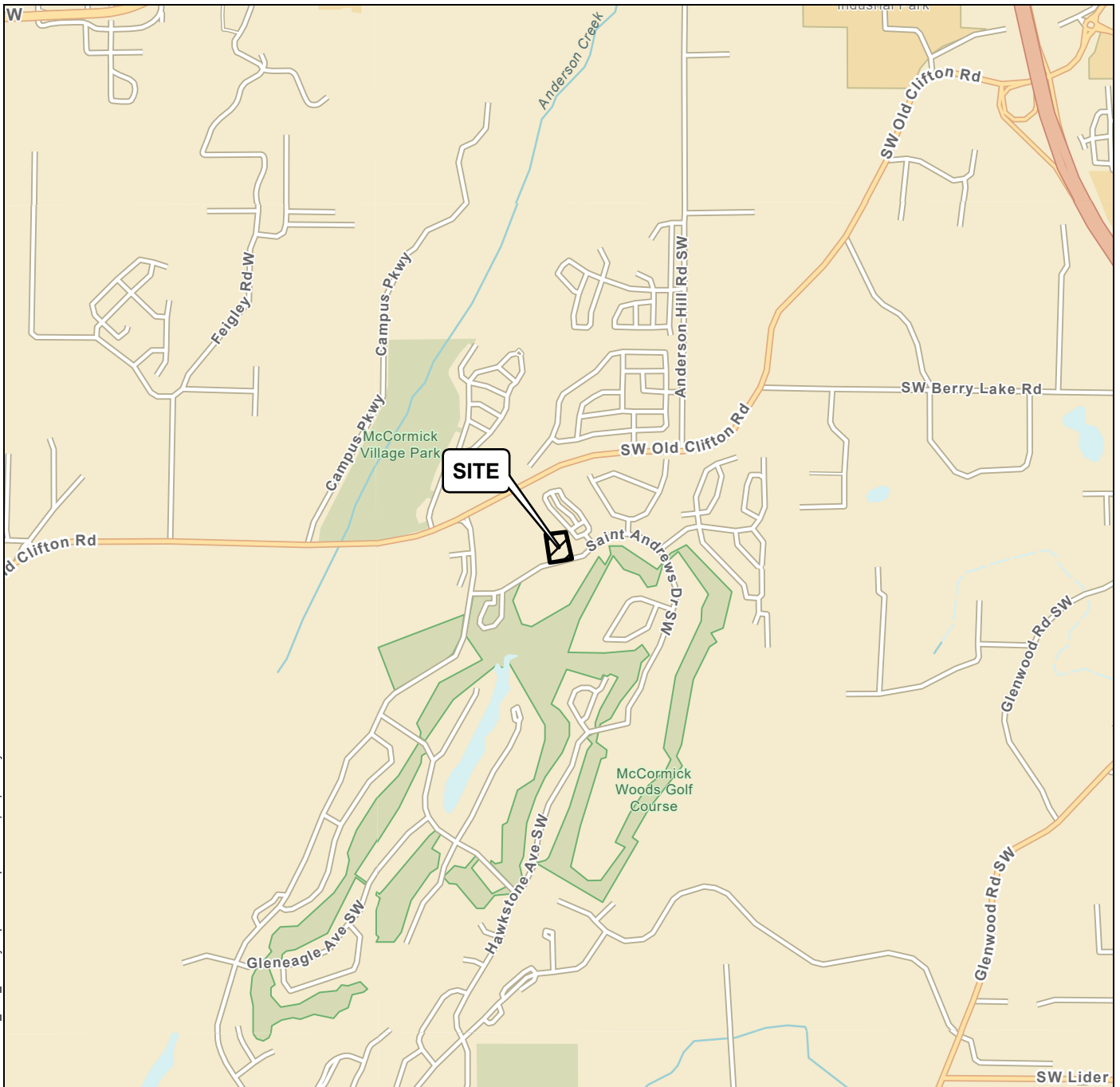
Trench backfill material placed below structures and footings should be compacted to at least 95 percent of the MDD. In paved areas, trench backfill should be uniformly compacted in horizontal lifts to at least 95 percent of the MDD in the upper 2 feet below subgrade. Fill placed below a depth of 2 feet from subgrade in paved areas must be compacted to at least 90 percent of the MDD. In non-structural areas, trench backfill should be compacted to a firm condition that will support construction equipment, as necessary.

5.0 LIMITATIONS

We have prepared this report for Murraysmith, for the City of Port Orchard Well 11 Improvements project located in Port Orchard, Washington. Murraysmith may distribute copies of this report to owner and owner's authorized agents and regulatory agencies as may be required for the project.

Our services have been executed in accordance with generally accepted practices for geotechnical engineering in this area at the time this report was prepared. The conclusions, recommendations, and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to the services or this report.

Please refer to Appendix C, Report Limitations and Guidelines for Use, for additional information pertaining to use of this report.



Vicinity Map

**McCormick Woods Well 11 Site Improvements
Port Orchard, Washington**



Figure 1

Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

Data Source: ESRI

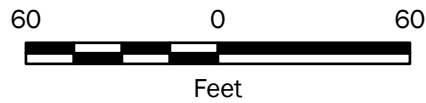
Projection:



P:\12\12309018_GIS\1230901800_Project.aprx\1230901800_Project Date Exported: 10/07/21 by ccabrera

Legend

 Borings by GeoEngineers, 2021




Notes:

1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.

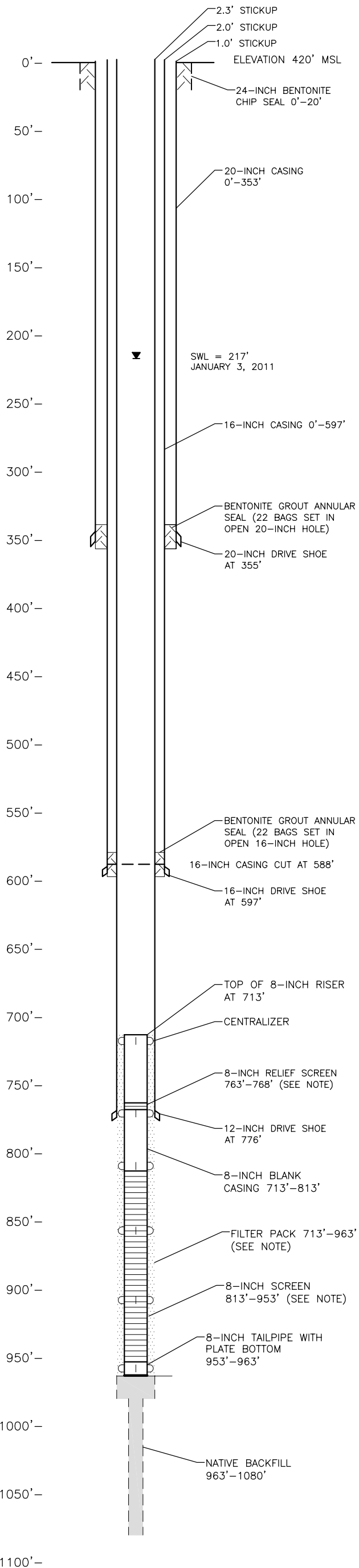
Data Source: ESRI Clarity

Projection: NAD 1983 StatePlane Washington North FIPS 4601 Feet

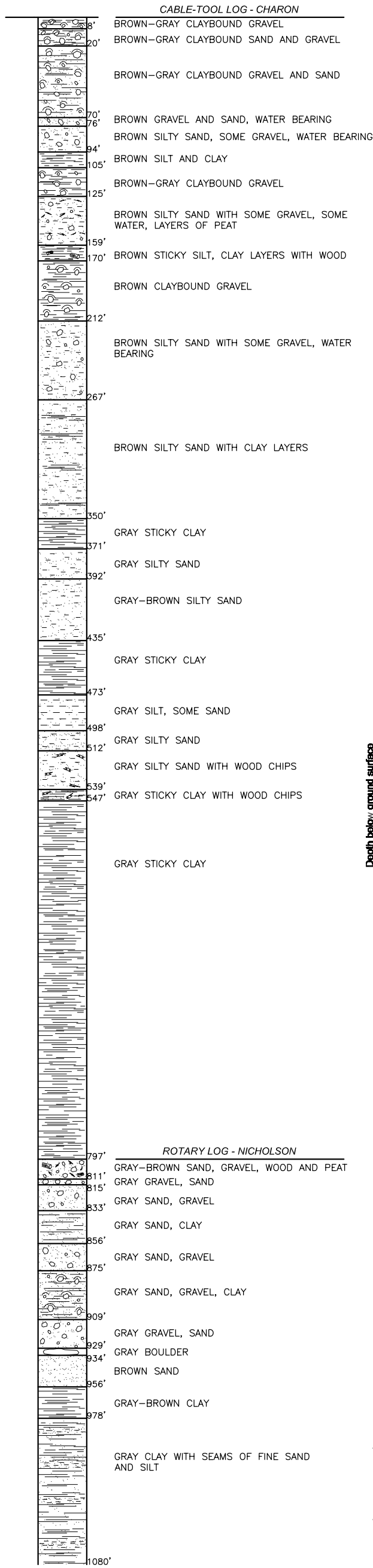
Site Plan	
McCormick Woods Well 11 Site Improvements Port Orchard, Washington	
	Figure 2

APPENDIX A
Well 11 Geologic Log

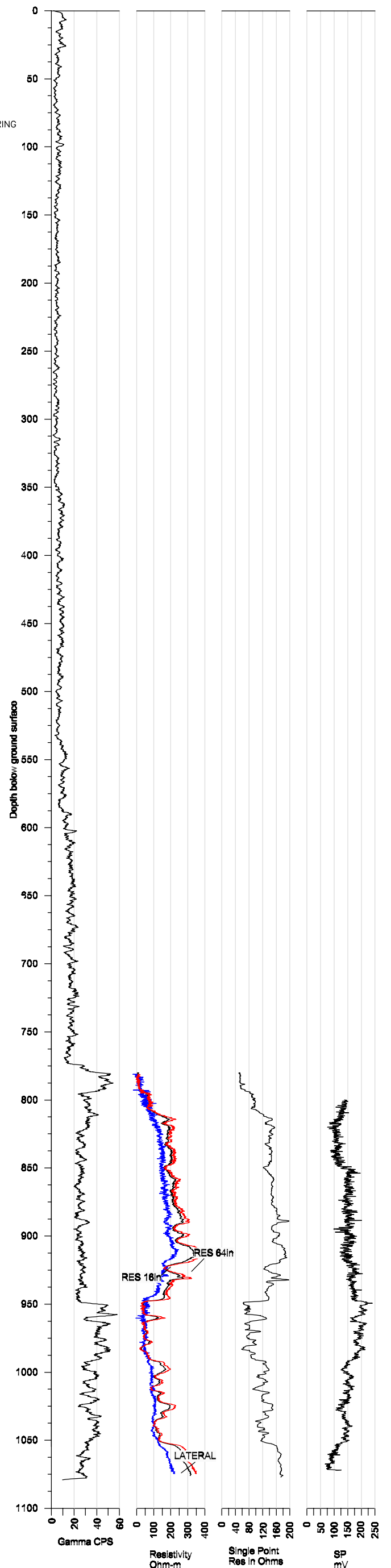
Construction Detail



Geologic Log



Geophysical Logs



PM: DCD
 1738-007A
 March 2011
 T 23 N/R 01 E - 09
 Kitsap County

NOTE: Well screens are 8-inch diameter, 40-slot (0.040-inch opening) pipe size stainless steel. Filter pack is 8X12 Colorado Silica Sand product.

Figure 2
 Construction Detail, Geologic and Geophysical Logs for Well 11
 City of Port Orchard: Well 11 Drilling Project

APPENDIX B
Subsurface Explorations and Laboratory Testing

APPENDIX B SUBSURFACE EXPLORATIONS AND LABORATORY TESTING

Subsurface Explorations

Soil conditions at the project site were explored by advancing two borings on September 20, 2021 and. The approximate locations of our explorations and shown on Figure 2. The explorations were located in the field using a GPS device. The locations of the explorations shown on the Site Plan (Figure 2) should be considered approximate.

Soil borings were advanced to nominal depths of about 50.5 feet below ground surface (bgs) using a track-mounted hollow-stem auger drill rig equipment and operators under subcontract to GeoEngineers. The explorations were continuously monitored by a representative from our firm who examined and classified the soil encountered, obtained representative soil samples, and maintained a detailed log of the explorations. Soil encountered in the borings was classified in general accordance with ASTM International (ASTM) D 2488 and the classification chart listed in Key to Exploration Logs, Figure B-1. Logs of the borings are presented in Figures B-2 and B-3. The logs are based on interpretation of the field and laboratory data and indicate the depth at which we interpret subsurface materials or their characteristics to change, although these changes might actually be gradual.

Soil samples were obtained from the borings at approximate 2.5- to 5-foot-depth intervals using a 2-inch, outside-diameter, standard split-spoon sampler (Standard Penetration Test [SPT]) in general accordance with ASTM D 1586. The samplers were driven into the soil using a 140-pound automatic hammer, free-falling 30 inches. The number of blows required to drive the samplers each of three, 6-inch increments of penetration were recorded in the field. The sum of the blow counts for the final 12 inches of penetration, unless otherwise noted, is reported on the boring logs.

Laboratory Testing

Soil samples obtained from the borings were returned to our laboratory for further examination and testing. The testing completed on each sample is presented in the corresponding boring log. A description of the laboratory testing completed on this project is provided below.

Grain-Size Analysis

Grain-size analyses were performed on selected soil samples in general accordance with ASTM Test Method C 136. This test provides a quantitative determination of the distribution of particle sizes in soils. Figure B-4 presents the results of the grain-size analyses.

Percent Passing the U.S. No. 200 Sieve

Selected samples were “washed” through the U.S. No. 200 sieve to estimate the relative percentages of coarse- and fine-grained particles in the soil. The percent passing value represents the percentage by weight of the sample finer than the U.S. No. 200 sieve (fines). The tests were conducted in general accordance with ASTM D 1140. The test results are presented on the exploration logs in Appendix B at the respective sample depths.

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS	GRAVEL AND GRAVELLY SOILS	CLEAN GRAVELS <small>(LITTLE OR NO FINES)</small>		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES <small>(APPRECIABLE AMOUNT OF FINES)</small>		GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES
		GRAVELS WITH FINES <small>(APPRECIABLE AMOUNT OF FINES)</small>		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
	SAND AND SANDY SOILS	CLEAN SANDS <small>(LITTLE OR NO FINES)</small>		SW	WELL-GRADED SANDS, GRAVELLY SANDS
		SANDS WITH FINES <small>(APPRECIABLE AMOUNT OF FINES)</small>		SP	POORLY-GRADED SANDS, GRAVELLY SAND
		SANDS WITH FINES <small>(APPRECIABLE AMOUNT OF FINES)</small>		SM	SILTY SANDS, SAND - SILT MIXTURES
FINE GRAINED SOILS	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS, ROCK FLOUR, CLAYEY SILTS WITH SLIGHT PLASTICITY
		LIQUID LIMIT LESS THAN 50		CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		LIQUID LIMIT LESS THAN 50		OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS SILTY SOILS
		LIQUID LIMIT GREATER THAN 50		CH	INORGANIC CLAYS OF HIGH PLASTICITY
		LIQUID LIMIT GREATER THAN 50		OH	ORGANIC CLAYS AND SILTS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS	

NOTE: Multiple symbols are used to indicate borderline or dual soil classifications

Sampler Symbol Descriptions

	2.4-inch I.D. split barrel
	Standard Penetration Test (SPT)
	Shelby tube
	Piston
	Direct-Push
	Bulk or grab
	Continuous Coring

Blowcount is recorded for driven samplers as the number of blows required to advance sampler 12 inches (or distance noted). See exploration log for hammer weight and drop.

"P" indicates sampler pushed using the weight of the drill rig.

"WOH" indicates sampler pushed using the weight of the hammer.

NOTE: The reader must refer to the discussion in the report text and the logs of explorations for a proper understanding of subsurface conditions. Descriptions on the logs apply only at the specific exploration locations and at the time the explorations were made; they are not warranted to be representative of subsurface conditions at other locations or times.

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS		TYPICAL DESCRIPTIONS
GRAPH	LETTER	
	AC	Asphalt Concrete
	CC	Cement Concrete
	CR	Crushed Rock/Quarry Spalls
	SOD	Sod/Forest Duff
	TS	Topsoil

Groundwater Contact



Measured groundwater level in exploration, well, or piezometer



Measured free product in well or piezometer

Graphic Log Contact

Distinct contact between soil strata

Approximate contact between soil strata

Material Description Contact

Contact between geologic units

Contact between soil of the same geologic unit

Laboratory / Field Tests

%F	Percent fines
%G	Percent gravel
AL	Atterberg limits
CA	Chemical analysis
CP	Laboratory compaction test
CS	Consolidation test
DD	Dry density
DS	Direct shear
HA	Hydrometer analysis
MC	Moisture content
MD	Moisture content and dry density
Mohs	Mohs hardness scale
OC	Organic content
PM	Permeability or hydraulic conductivity
PI	Plasticity index
PL	Point load test
PP	Pocket penetrometer
SA	Sieve analysis
TX	Triaxial compression
UC	Unconfined compression
VS	Vane shear

Sheen Classification

NS	No Visible Sheen
SS	Slight Sheen
MS	Moderate Sheen
HS	Heavy Sheen

Key to Exploration Logs



Figure B-1

Drilled	Start 9/20/2021	End 9/20/2021	Total Depth (ft)	50.5	Logged By Checked By	LP BEL	Driller	Holocene Drilling	Drilling Method	Hollow-stem Auger
Surface Elevation (ft) Vertical Datum	421 NAVD88			Hammer Data	Autohammer 140 (lbs) / 30 (in) Drop			Drilling Equipment	Diedrich D50	
Easting (X) Northing (Y)	1182643 189652			System Datum	WA State Plane North NAD83 (feet)			Groundwater not observed at time of exploration		
Notes:										

Elevation (feet)	FIELD DATA					Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing						
420	0					SOD	Approximately 2 inches of sod				
						SM	Gray silty fine to coarse sand with occasional gravel (very dense, moist) (glacially consolidated soils)				
		12	50/6"		1 SA			5	30		
415	5	18	45		2 SA		Grades to with gravel, becomes dense	7	30		
410	10	11	50/5"		3		Becomes very dense				
405	15	6	50/6"		4 %F			7	32		
400	20	6	50/6"		5						
395	25	5	50/6"		6		SM Gray silty fine to coarse sand with gravel (very dense, moist)				
390	30	5	50/6"		7						
35						SM	Gray silty fine to coarse sand (very dense, moist)				

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Boring B-1



Project: McCormick Woods Well 11 Site Improvements
Project Location: Port Orchard, Washington
Project Number: 12309-018-00

Figure B-2
Sheet 1 of 2

Date: 10/27/21 Path: \\GEOENGINEERS.COM\WAN\PROJECTS\12\12309018\GINT\1230901800.GPJ DBLibrary\Library\GEOENGINEERS_DF_STD_US_JUNE_2017\GLB\GER_GEO TECH_STANDARD_SF_NO_GW

Date: 10/27/21 Path: \\GEOENGINEERS.COM\WAN\PROJECTS\12\12309018\GINT\1230901800.GPJ DBLibrary\Library\GEOENGINEERS_DF_STD_US_JUNE_2017.GLB\GEB8_GEOTECH_STANDARD_SF_NO_SW

Elevation (feet)	FIELD DATA				Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample						
385	35	5	50/5"		8	SM	Gray to brown silty fine to medium sand with gravel (very dense, moist)			
380	40		50/6"		9					
375	45	11	50/5"		10					
50	50	6	50/6"		11					

Boring terminated at approximately 50½ feet below ground surface.

Log of Boring B-1 (continued)



Project: McCormick Woods Well 11 Site Improvements
 Project Location: Port Orchard, Washington
 Project Number: 12309-018-00

Start Drilled	9/20/2021	End		Total Depth (ft)	50.75	Logged By	LP	Checked By	BEL	Driller	Holocene Drilling	Drilling Method	Hollow-stem Auger
Surface Elevation (ft)	418	Vertical Datum	NAVD88	Hammer Data		Autohammer	140 (lbs) / 30 (in) Drop	Drilling Equipment		Diedrich	D50		
Easting (X)	1182532	Northing (Y)	189699	System Datum		WA State Plane North	NAD83 (feet)	See "Remarks" section for groundwater observed					
Notes:													

Elevation (feet)	FIELD DATA					Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample	Sample Name Testing						
0						SOD	Approximately 2 inches of sod				
4.15		18	54		1 SA	SM	Brown silty fine to coarse sand with gravel (medium dense, moist) (fill)	8	30		
5		18	47		2		Becomes dense				
4.10							Becomes very dense				
10		11	50/5"		3 SA			8	33		
4.05											
15		11	50/5"		4 %F	SM	Gray fine to medium silty sand with occasional gravel (very dense, moist)	4	17		
4.00											
20		12	50/6"		5						
3.95											
25		18	80		6A 6B	ML	Becomes wet Gray sandy silt (hard, moist)				Perched groundwater observed at 25 feet during drilling
3.90											
30		11	50/5"		7	SM	Gray to brown silty fine to coarse sand with gravel (very dense, moist)				
3.85											
35											

Note: See Figure B-1 for explanation of symbols.
Coordinates Data Source: Horizontal approximated based on USGS Topo. Vertical approximated based on USGS Topo.

Log of Boring B-2



Project: McCormick Woods Well 11 Site Improvements
Project Location: Port Orchard, Washington
Project Number: 12309-018-00

Date: 10/27/21 Path: \\GEOENGINEERS.COM\WAN\PROJECTS\12\12309018\GINT\1230901800.GPJ DBLibrary\Library\GEOENGINEERS_DF_STD_US_JUNE_2017\GLB\GER_GEO TECH_STANDARD_SF_NO_GW

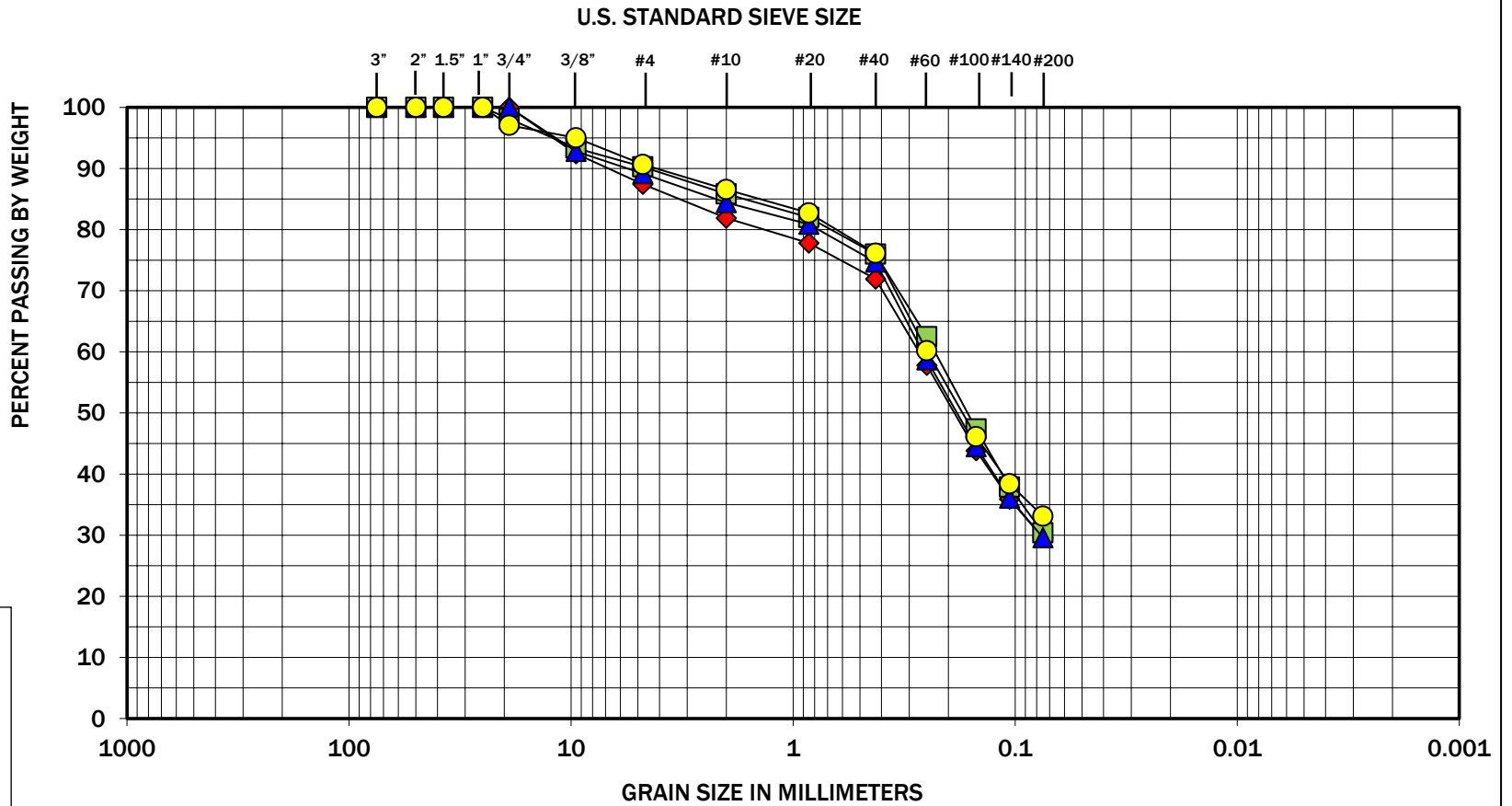
Date: 10/27/21 Path: \\GEOENGINEERS.COM\WAN\PROJECTS\12\12309018\GINT\1230901800.GPJ DBLibrary\Library\GEOENGINEERS_DF_STD_US_JUNE_2017.GLB\GEB8_GEOTECH_STANDARD_SF_NO_SW

Elevation (feet)	FIELD DATA				Graphic Log	Group Classification	MATERIAL DESCRIPTION	Moisture Content (%)	Fines Content (%)	REMARKS
	Depth (feet)	Interval Recovered (in)	Blows/foot	Collected Sample						
35	35	8	50/2"		8					
380										
40	40	11	50/5"		9					Increased moisture content at 40 feet
375										
45	45	11	50/5"		10	SP-SM	Gray fine to coarse sand with silt and gravel (very dense, moist)			
370										
50	50	10	50/4"		11					
Boring terminated at approximately 50¾ feet below ground surface.										

Log of Boring B-2 (continued)



Project: McCormick Woods Well 11 Site Improvements
 Project Location: Port Orchard, Washington
 Project Number: 12309-018-00



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

Symbol	Boring Number	Depth (feet)	Moisture (%)	Laboratory Soil Description
◆	B-1	2.5	5	Silty sand (SM)
■	B-1	5	7	Silty sand (SM)
▲	B-2	2.5	8	Silty sand (SM)
●	B-2	10	8	Silty sand (SM)



Note: This report may not be reproduced, except in full, without written approval of GeoEngineers, Inc. Test results are applicable only to the specific sample on which they were performed, and should not be interpreted as representative of any other samples obtained at other times, depths or locations, or generated by separate operations or processes.

The grain size analysis results were obtained in general accordance with ASTM C 136. GeoEngineers 17425 NE Union Hill Road Ste 250, Redmond, WA 98052

GEOENGINEERS

McCormick Woods Well 11 Site Improvements
Port Orchard, Washington

Sieve Analysis Results

Figure-B-4

APPENDIX C

Report Limitations and Guidelines for Use

APPENDIX C REPORT LIMITATIONS AND GUIDELINES FOR USE¹

This appendix provides information to help you manage your risks with respect to the use of this report.

Report Use and Reliance

This report has been prepared for Murraysmith. GeoEngineers structures its services to meet the specific needs of its clients. No party other than Murraysmith may rely on the product of our services unless we agree to such reliance in advance and in writing. Within the limitations of the agreed scope of services for the Project, and its schedule and budget, our services have been executed in accordance with signed agreement for this project dated August 5, 2021 and generally accepted geotechnical practices in this area at the time this report was prepared. We do not authorize, and will not be responsible for, the use of this report for any purposes or Projects other than those identified in this report.

If changes to the Project or property occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations in the context of such changes. Based on that review, we can provide written modifications or confirmation, as appropriate.

Information Provided by Others

GeoEngineers has relied upon certain data or information provided or compiled by others in the performance of our services. Although we use sources that we reasonably believe to be trustworthy, GeoEngineers cannot warrant or guarantee the accuracy or completeness of information provided or compiled by others.

Conditions Can Change

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Professional Judgment

It is important to recognize that the geoscience practices (geotechnical engineering, geology and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to its services, GeoEngineers includes these

¹ Developed based on material provided by ASFE, Professional Firms Practicing in the Geosciences; www.asfe.org.

explanatory “limitations” provisions in its reports. Please confer with GeoEngineers if you need to know how these “Report Limitations and Guidelines for Use” apply to your Project or site.

**APPENDIX B
PERMITS
(LDAP AND SDP TO BE ISSUED DURING BID)**

APPENDIX C
WASHINGTON STATE DEPARTMENT OF HEALTH DWSRF
CONTRACT DOCUMENTS

It is important for the contract to specify that the contractor will notify the borrower if it terminates the bond. Borrowers must notify their DWSRF contract manager if payment or performance bonds are terminated for any reason.

7.16 American Iron and Steel Provision

Congress passed a law January 17, 2014, that requires water systems to use U.S. steel and iron products for projects funded in part or in full by a Drinking Water State Revolving Fund (DWSRF) loan.

Contractors must submit an affidavit of certification (Attachment 4-D American Iron and Steel Certification) with construction reimbursement requests to demonstrate compliance with the American Iron and Steel requirement.

What types of iron and steel products are required?

The act defines iron and steel products as, "... the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials."

How do we verify that our iron and steel products are American?

To ensure compliance with the AIS requirement, DOH must include specific AIS contract language in the assistance agreement. We may also conduct site visits during construction and review documentation the loan recipient gathered to demonstrate proof of compliance. Recipients must be able to verify and document that all iron and steel products purchased as part of the construction project were produced in the United States.

Can I apply for a waiver to this requirement?

We will grant waivers on a product-by-product basis. EPA is preparing guidance on a national waiver that may apply to upcoming projects. DOH is also exploring the possibility of a waiver for projects that were in process when Congress passed the American Iron and Steel Provision.

In the meantime, you may be able to get a waiver if the EPA administrator decides:

- The requirements are inconsistent with the public interest.
- The U.S. doesn't produce iron and steel products in sufficient and reasonably available quantities and of a satisfactory quality.
- Including U.S. iron and steel products will increase the cost off the overall project by more than 25 percent.

We are available to help you with your waiver requests. If a waiver will be required for an iron or steel product used in your project, the best time to obtain a waiver is during design of the project. These waivers may affect the applicability of American Iron and Steel requirements.

If this increases the cost of my project, can I get additional funds?

DWSRF loan cycle recipients that don't meet the exemptions listed above may request additional funding when American Iron and Steel requirements cause the bid to exceed previously estimated construction costs. We may provide additional SRF loan funds if they are available.

Where can I get more information?

U.S. EPA, Region 10, Drinking Water State Revolving Fund:
Richard Green, green.richard@epamail.epa.gov, or 206-553-8504

7.17 Develop the Contract Document

Borrowers must incorporate all the clauses and provisions that were in the construction IFB packet into the construction contract. The prime contractor also must pass all provisions required in the prime contract on to all subcontractors, including the Labor Standards Provisions.

7.18 Receive Sealed Bids

Borrowers should log all bids received with the time and date of receipt and keep them in a secure place.

A borrower located in a rural area of the state who has difficulty soliciting bids for construction projects, along with advertising for competitive bid in the local newspaper, may solicit bids directly from general contractors as part of the bidding process.

7.19 Conduct Bid Opening

Borrowers must open bids in public at the time and place stated in the advertisement. You can delay the bid opening, but you must notify all the bidders in advance. If you delay a bid opening, all bidders should have the opportunity to withdraw their bids or to resubmit them just before the new bid opening date and time (cost of equipment or materials could increase). You should conduct the public bid opening in a business-like manner. You must read each bid aloud during the meeting and determine the apparent low bidder. You must maintain a description of the bid review and tabulation process in your project files.

If you receive no bids, or the received bids are too costly, re-advertise the bid ad in a wider geographic area. We encourage borrowers to maintain a list of reputable general contractors that have done good work for them in the past or have bid previous projects in order to alert them of the bid request.

7.20 Select the Lowest Responsible Bidder

The bids received should show in detail the estimated total cost of the work, a unit price for each component of the project, its overall individual cost, and the estimated completion schedule for each phase. The lowest responsible bidder must:

- Be licensed to work in Washington State.
- Have the ability, capacity, and skill to perform the work described in the contract scope of work and comply with requirements within the indicated timeframes.

Attachment 7-A: Example of Advertisement for Construction Contract Bids

City of Devin

Business Development Building

Bid Date, September 1, 2016

Estimated Cost of Project: \$1,200,000.00

INVITATION FOR BIDS

Sealed bids will be received by the City of Devin Public Works Office, located at 130 SE Cascade Avenue, PO Box 413, Devin, WA 98684, until 2 P.M., September 21, 2016, for the general contract for construction of a water reservoir. The project consists of constructing a 180-foot tall water reservoir and removal of a 100-foot-tall elevated tank.

Bidding documents for the project are prepared by Delco Engineering, Inc., P.S.

Availability of Bidding Documents: Bona fide general contractors may obtain the contract documents at the office of Delco Engineering, Inc., P.S., located at 1313 West Clark, Nimbi, WA 99301, (509) 454-4402 on payment of \$75 per set. Copies of the contract documents may be examined at the following locations: Portland Plan Center, 1125 SE Madison, Portland OR; Associated General Contractors, 1200 Westlake North, Seattle, WA; 528 N. 20th, Yakima, WA; Spokane Construction Council, E. 102 Boone Street, Spokane, WA; Tri-City Construction Council, 34 Vista Way, Kennewick, WA; Associated Women Contractors, 921 South Elm, Seattle WA.

Bid Security: A certified or bank cashier's check for 5 percent of the bid amount, payable to the City of Devin, or bid bond executed by a licensed bonding company is required with each bid.

Rejection of Bids: The city shall have the right to reject any or all bids not accompanied by bid security or data required by the bidding document or a bid in any way incomplete or irregular.

The City of Devin is an equal opportunity and affirmative action employer. Disadvantaged Business Enterprises (Small, Minority- and Women-Owned Businesses) are encouraged to submit bids. All work performed on the project will be subject to the higher of the prevailing state or federal wage rates.

The bids will be open at 2 P.M., September 21, 2016, at the offices of Devin Public Works Department, located at 130 SE Cascade Avenue, Devin WA. For more information, call Shawn Gomez at 509-427-5484.

This project is fully or partially funded through the Washington State Drinking Water State Revolving Fund Program with federal funds from the U.S. Environmental Protection Agency. General contractors and all subcontractors must meet DWSRF requirements and provisions.

Attachment 7-B: Notice of Contract Award and Notice to Proceed

NOTIFICATION OF CONTRACT AWARD AND START OF CONSTRUCTION

AGENCY: _____ CONTRACT NUMBER: _____

DATE OF NOTICE TO PROCEED: _____

CONTRACT AWARD DATE: _____

PROJECT NAME: _____ CONTRACT AMOUNT: _____

PROJECT LOCATION: _____

GENERAL CONTRACTOR: _____

DATE BID SOLICITATION PUBLISHED*: _____

BID OPENING DATE: _____ NUMBER OF BIDS RECEIVED: _____

NAMES/ADDRESSES OF DISADVANTAGED BUSINESS ENTERPRISE SOLICITED: _____

APPLICABLE FEDERAL WAGE DECISION NUMBER**: _____

MODIFICATIONS**: _____

PRECONSTRUCTION CONFERENCE DATE: _____

CONSTRUCTION START DATE: _____

SUBMITTED BY: _____

SIGNATURE: _____ TITLE: _____

PRINTED NAME: _____

ADDRESS: _____

*Please attach copy of published bid solicitation advertisement. *

**Federal Funded Contracts (CDBG & DWSRF) **

PLEASE NOTE: Federally funded projects must pay the higher of federal or state prevailing wages.

Attachment 7-C: Bid Checklist

The bid documents must include the following information and materials.

- Identify source of federal assistance
- Identify Jurisdiction
- Contact person and phone number
- Date, time and place of public bid opening
- Basis for rejecting bids
- Any factors, in addition to lowest price, which will determine the lowest, responsible bidder, or responsive bid
- Includes Washington State license requirement
- Clear, accurate description of the technical requirements for materials, products, or services (specifications)
- Plans and other pertinent attachments

Federal Requirements

Disadvantaged Business Enterprise

- General Compliance (40CFR Part 33)
- Fair Share Goals
- Nondiscrimination Provision
- Preventing Unfair DBE Practices
- EPA Forms 6100-2, 6100-3, & 6100-4 for Disadvantaged Business Enterprises
- Bidders List
- Specify that a five percent (5%) bid guarantee is required
- Bond requirements (for municipal borrowers only)
 - Specify if a 100% Performance Bond is required on contracts of \$100,000 +
 - Specify if a 100% Payment Bond is required on contract of \$100,000 +

Labor Standards Provisions (Attachment 7-D or 7-E)

- Applicable Federal Wage Decision
- Applicable State Wage Decision
- Equal Opportunity and Affirmative Action Provisions (referenced in the General Terms and conditions of the contract)
- American Iron and Steel Requirement

Attachment 7-D: Bid Spec Insert for Municipal Borrowers (Pages 47-74)

WASHINGTON STATE DEPARTMENT OF HEALTH DRINKING WATER STATE REVOLVING FUND (DWSRF)

SPECIFICATIONS INSERT MUNICIPAL

The following clauses will be incorporated into construction contracts receiving financial assistance from the Washington State Department of Health Drinking Water State Revolving Fund. In the event of conflict within the contract, these clauses shall take precedence.

Required Bid Submittals

The following submittals must be submitted with the bid proposal:

- ➔ Complete Bidders List

Compliance with State and Local Laws

The contractor shall ensure compliance with all applicable federal, state, and local laws, requirements, and ordinances as they pertain to the design, implementation, and administration of the approved project.

Civil Rights

All contracts must include and comply with the following:

Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d

No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance.

Section 504 of the Rehabilitation Act of 1973, 29 U.S.C. § 794

No otherwise qualified individual with a disability in the United States shall, solely by reason of his or her disability, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving federal financial assistance.

The Age Discrimination Act of 1975, 42 U.S.C. § 6102

No person in the United States shall, on the basis of age, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving financial assistance.

Equal Employment Opportunity, Executive Order No. 11246 (1965)

Through a series of Executive Orders, and a decision by the Equal Employment

Opportunity Commission, the federal government has established a national policy designed to battle discrimination based on race, color, sex, religion, and national origin in federal assistance programs and to enhance hiring, training, and promotion opportunities for minorities and women in construction programs financed, in part, by federal dollars.

If a contract exceeds \$10,000, the contractor shall comply with Executive Order 11246, "Equal Employment Opportunity," as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and as supplemented by regulations at 41 CFR part 60.

Contractor's compliance with Executive Order 11246 shall be based on implementation of the Equal Opportunity Clause, and specific affirmative active obligations required by the Standard Federal Equal Employment Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4.

Must be included in all contracts:

Equal Opportunity Clause (41 CFR part 60-1.4(b))

During the performance of this contract, the contractor agrees as follows:

1. The contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. The contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment without regard to their race, color, religion, sex, or national origin. Such action shall include, but not be limited to the following: Employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.
2. The contractor will, in all solicitations or advertisements for employees placed by or on behalf of the contractor, state that all qualified applicants will receive considerations for employment without regard to race, color, religion, sex, or national origin.
3. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representatives of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment.
4. The contractor will comply with all provisions of Executive Order 11246 of September 24, 1965, and of the rules, regulations, and relevant orders of the Secretary of Labor.

5. The contractor will furnish all information and reports required by Executive Order 11246 of September 24, 1965, and by rules, regulations, and orders of the Secretary of Labor, or pursuant thereto, and will permit access to his books, records, and accounts by the administering agency and the Secretary of Labor for purposes of investigation to ascertain compliance with such rules, regulations, and orders.
6. If the contractor doesn't comply with the nondiscrimination clauses of this contract or with any of the said rules, regulations, or orders, this contract may be canceled, terminated, or suspended in whole or in part and the contractor may be declared ineligible for further government contracts or federally assisted construction contracts according to procedures authorized in Executive Order 11246 of September 24, 1965, and such other sanctions may be imposed and remedies invoked as provided in Executive Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.
7. The contractor will include the portion of the sentence immediately preceding paragraph (1) and the provisions of paragraphs (1) through (7) in every subcontract or purchase order unless exempted by rules, regulations, or orders of the Secretary of Labor issued pursuant to section 204 of Executive Order 11246 of September 24, 1965, so that such provisions will be binding on each subcontractor or vendor. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for noncompliance: Provided, however, That in the event a contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of such direction by the administering agency the contractor may request the United States to enter into such litigation to protect the interests of the United States.

Federal Equal Employment Opportunity Construction Contract Specifications

(Executive Order 11246 and 41 CFR part 60-4.3)

1. As used in these specifications:
 - a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
 - b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
 - c. "Employer identification number" means the federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
 - d. "Minority" includes:
 - i. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - ii. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);

- iii. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
 - iv. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the contractor, or any subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
3. If the contractor is participating (pursuant to 41 CFR 60–4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the plan area (including goals and timetables) shall be according to that plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each contractor or subcontractor participating in an approved plan is individually required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good faith performance by other contractors or subcontractors toward a goal in an approved plan does not excuse any covered contractor's or subcontractor's failure to take good faith efforts to achieve the plan goals and timetables.
4. The contractor shall implement the specific affirmative action standards provided in paragraphs 7a through 7p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered construction contractors performing construction work in geographical areas where they do not have a federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where they perform the work. Goals periodically appear in the Federal Register notice form. You can obtain such notices from any Office of Federal Contract Compliance Programs or from federal procurement contracting officers. The contractor is expected to make uniform progress in meeting its goals in each craft during the period specified.
5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the contractor's obligations under these specifications, Executive Order 11246, nor the regulations promulgated pursuant thereto.
6. To count the nonworking training hours of apprentices and trainees in meeting the goals, the contractor must employ such apprentices and trainees during the training period, and make a commitment to employ them at the completion of their training, subject to the availability of

employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

7. The contractor shall take specific affirmative action's to ensure equal employment opportunity. The evaluation of the contractor's compliance with these specifications shall be based on its effort to achieve maximum results from its actions. The contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
 - a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities where the contractor assigns employees to work. The contractor, where possible, will assign two or more women to each construction project. The contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
 - b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
 - c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and the action taken with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the contractor by the union or, if referred, not employed by the contractor, this shall be documented in the file with the reason therefore, along with whatever additional actions the contractor may have taken.
 - d. Provide immediate written notification to the director of the Federal Contract Compliance Program when the union or unions the contractor has a collective bargaining agreement with doesn't refer to the contractor, a minority person or woman sent by the contractor, or when the contractor has other information that the union referral process has impeded the contractor's efforts to meet its obligations.
 - e. Develop on-the-job training opportunities or participate in training programs for the area, which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the contractor's employment needs, especially programs the Department of Labor funds or approves. The contractor shall provide notice of these programs to the sources compiled under 7b above.
 - f. Disseminate the contractor's EEO policy by providing notice of the policy to unions and training programs and asking them to help the contractor meet its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper or annual report; by reviewing the policy with all management personnel and all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.

- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees that have any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel, such as superintendents or general foremen, before initiating construction work at any job site. The contractor must make and maintain a written record identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the contractor's EEO policy with other contractors and subcontractors with whom the contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women, and, where reasonable, provide after school, summer and vacation employment to minority and female youth both on the site and in other areas of a contractor's work force.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60–3.
- l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
- m. Continually monitoring all personnel and employment related activities to ensure seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect. Ensure that the EEO policy and the contractor's obligations under these specifications are carried out.
- n. Ensure that all facilities and company activities are unsegregated except that separate or single-user toilet and necessary changing facilities shall be provided to ensure privacy between the sexes.
- o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
- p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the contractor's EEO policies and affirmative action obligations.

8. We encourage contractors to participate in voluntary associations, which assist in fulfilling one or more of their affirmative action obligations (7a through 7p). The efforts of a contractor association, joint contractor-union, contractor community, or other similar group where the contractor is a member and participant, may be asserted as fulfilling one or more of its obligations under 7a through 7p of these specifications. As such, the contractor must actively participate in the group, make every effort to ensure the group has a positive impact on the employment of minorities and women in the industry, and ensure the contractor's minority and female workforce participation reflects the concrete benefits of the program. In addition, the contractor must make a good faith effort to meet individual goals and timetables and provide access to documentation that demonstrates the effectiveness of actions the group takes on the contractor's behalf. However, the contractor is obligated to comply and failure of such a group to fulfill an obligation shall not be a defense for noncompliance.
9. A single goal for minorities and a separate single goal for women were established. The contractor, however, must provide equal employment opportunity and take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the contractor may be in violation of the Executive Order if a particular group is employed in a disparate manner. For example, even if the contractor achieved a goal for women in general, it may be in violation of the Executive Order if it under utilizes a specific minority group of women.
10. The contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
11. The contractor shall not enter into any Subcontract with any person or firm debarred from government contracts pursuant to Executive Order 11246.
12. The contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.
13. The contractor, in fulfilling its obligations under these specifications, shall implement specific affirmative action steps, at least as extensive as the standards prescribed in paragraph 7 of these specifications, to achieve maximum results from its efforts to ensure equal employment opportunity. If the contractor fails to comply with the requirements of the Executive Order, the implementing regulations, or these specifications, the director of the Federal Contract Compliance Program shall proceed according to 41 CFR 60-4.8.
14. The contractor shall designate a responsible official to monitor all employment related activity to carry out the company EEO policy, to submit reports relating to the provisions hereof as the government may require, and to keep records. Records for each employee must include the name, address, telephone numbers, construction trade, union affiliation if any, employee identification number when assigned, social security number, race, sex, status (mechanic, apprentice trainee, helper, or laborer), dates of changes in status, hours worked per week in the

indicated trade, rate of pay, and locations where the work was performed. The contractor must maintain records in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, we won't require contractors to maintain separate records.

15. Nothing herein provided shall be construed as a limitation on the application of other laws, which establish different standards of compliance, or on the application of requirements for hiring local or other area residents (those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).



Reporting Requirements (EEO-1)

On or before September 30 of each year, a contractor subject to Title VII of the Civil Rights Act of 1964, as amended, that has 100 or more employees, must file an "Employer Information Report EEO-1" with the EEOC or its delegate. Instructions on how to file are on the EEOC website at eeoc.gov/employers/eeo1survey/howtofile.cfm. The contractor shall retain a copy of the most recent report filed.

Segregated Facilities (41 CFR part 60-1.8)

The contractor must provide facilities for employees in a manner that prevents segregation on the basis of race, color, religion, sex, or national origin. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensuring that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. This obligation extends to all contracts containing the equal opportunity clause regardless of the amount of the contract. The term "facilities," as used in this section, means waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, wash rooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees. Separate or single-user restrooms and necessary dressing or sleeping areas shall be provided to ensure privacy between the sexes.

a. Provision

While performing this contract, the contractor must comply with all federal and state nondiscrimination laws, including, but not limited to Chapter 49.60 RCW, Washington's Law against Discrimination, and 42 U.S.C. 12101 et seq, the Americans with Disabilities Act. If the contractor fails or refuses to comply with any applicable nondiscrimination law, regulation, or policy, DOH may rescind, cancel, or terminate this contract in whole or in part, and declare the contractor ineligible for further contracts. The contractor shall, however, be given reasonable time to cure this noncompliance.

The contractor must also include the following terms and conditions in contracts with all contractors, subcontractors, engineers, vendors, and any other entity for work or services listed in Attachment I: Scope of Work.

“The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this Contract. The contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under U.S. Environmental Protection Agency financial agreements. If the contractor fails to carry out these requirements, it is a material breach of this contract, which may result in contract termination.

American Iron and Steel Provision

Congress passed a law January 17, 2014, that requires water systems to use U.S. steel and iron products for projects funded in part or in full by a Drinking Water State Revolving Fund (DWSRF) loan.

The act defines iron and steel products as, “...the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.”

Prohibition Statement

While the contract is in effect, the contractor and its employees may not engage in severe forms of trafficking in persons, procure a commercial sex act, or use forced labor (Section 106 of the Trafficking Victims Protection Act of 2009, as amended). The contractor shall require this prohibition statement in contracts with all contractors, subcontractors, engineers, vendors, and any other entity for work or services listed in Attachment I: Scope of Work.

If the contractor or any of its employees is determined to have violated the terms of this section, this contract may be terminated.

Prevailing Wage

The work performed under this contract is subject to the wage requirements of the Davis-Bacon Act. The contractor and subcontractors must conform to wage requirements prescribed in the federal Davis-Bacon and Relate Acts. These acts require them to pay laborers and mechanics employed on contracts funded in whole or in part by SRF appropriations in excess of \$2,000, prevailing wage rates and fringe benefits for corresponding classes of laborers and mechanics employed on similar projects in the area. Attachment 1A or 1B to this specification insert, and an up-to-date wage determination **must** be included in full into **any** contract and in any subcontract in excess of \$2,000. You can find wage determinations at www.wdol.gov.

Certification Regarding Suspension, Debarment, Ineligibility or Voluntary Exclusion

1. The contractor, by signing this agreement, certifies that it is not suspended, debarred, proposed for debarment, declared ineligible or otherwise excluded from contracting with the federal government, or from receiving contracts paid for with federal funds. If the contractor is unable to certify to the statements contained in the certification, they must provide an explanation as to why they cannot.

2. The contractor shall provide immediate written notice to DOH if at any time it learns that its certification was erroneous when submitted or became erroneous due to changed circumstances.
3. The terms covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used in this clause, have the meaning set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may ask DOH for help obtaining a copy of those regulations.
4. The contractor agrees it shall not knowingly enter into any lower tier covered transaction with a person proposed for debarment under the applicable Code of Federal Regulations, debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction.
5. The contractor further agrees by signing this agreement, that it will include the clause titled, "Certification Regarding Suspension, Debarment, Ineligibility Or Voluntary Exclusion," without modification in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
6. Pursuant to 2CFR180.330, the contractor must ensure that any lower tier covered transaction complies with certification of suspension and debarment requirements.
7. The contractor acknowledges that failing to disclose the information required in the Code of Federal Regulations may result in the delay or negation of this funding agreement, or cause DOH to pursue legal remedies, including suspension and debarment.
8. The contractor agrees to keep proof in its agreement file, that it, and all lower tier recipients or contractors, are not suspended or debarred, and will make this proof available to the DOH on request. The recipient or contractor must run a search in www.Beta.sam.gov and print a copy of completed searches to document proof of compliance.

This term and condition supersedes EPA Form 5700-49, "Certification Regarding Debarment, Suspension, and Other Responsibility Matters."

Disadvantaged Business Enterprises (Temporarily suspended)

Small, minority and women-owned firms should be afforded the maximum opportunity to compete for and obtain bid documents for DWSRF-funded projects. The level of participation by small, minority and women-owned firms should be consistent with their general availability within the professional community involved.

General Compliance (40 CFR Part 33).

The contractor shall comply with the requirements of the U.S. Environmental Protection Agency's Program for Participation by Disadvantaged Business Enterprises (DBE) 40 CFR Part 33.

Non-discrimination Provision (40CFR Appendix A to Part 33).

The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. The contractor's failure to carry out these requirements is a material breach of this contract, which may result in contract termination or other legally available remedies.

The contractor shall comply with all federal and state nondiscrimination laws, including, but not limited to Title VI and VII of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, and Chapter 49.60 RCW, Washington's Law Against Discrimination, and 42 U.S.C. 12101 et seq, the Americans with Disabilities Act (ADA).

Six Good Faith Efforts (40 CFR Part 33 Subpart C).

The contractor agrees to make the following good faith efforts whenever procuring subcontracts, equipment, services, and supplies. The contractor shall retain records documenting compliance with the following six good faith efforts.

1. Ensuring Disadvantaged Business Enterprises are made aware of contracting opportunities to the full extent practicable through outreach and recruitment activities. For tribal, state and local and government recipients, this will include placing Disadvantaged Business Enterprises on solicitation lists and soliciting them whenever they are potential sources. You can find Qualified Women and Minority business enterprises online at www.omwbe.wa.gov or by contacting the Washington State Office of Minority and Women's Enterprises at 360-704-1181.
2. Making information on forthcoming opportunities available to Disadvantaged Business Enterprises and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by Disadvantaged Business Enterprises in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for at least 30 calendar days before the bid or proposal closing date.
3. Considering in the contracting process whether firms competing for large contracts could subcontract with Disadvantaged Business Enterprises. For tribal, state and local government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by Disadvantaged Business Enterprises in the competitive process.
4. Encourage contracting with a consortium of Disadvantaged Business Enterprises when a contract is too large for one of these firms to handle individually.
5. Using services and assistance of the Small Business Administration and the Minority Business Development Agency of the U.S. Department of Commerce.

6. If the prime contractor awards subcontracts, requiring the subcontractors to take the six good faith efforts in paragraphs 1 through 5 above.

Fair Share Objective Goal (40 CFR Part 33 Subpart D).

A fair share objective is a goal based on the capacity and availability of qualified, certified Minority Business Enterprises (MBEs) and Women’s Business Enterprises (WBEs) in the relevant geographic market. As mandated by EPA, all general contractors and subcontractors must comply with the requirements of the EPA’s Program for Utilization of Small, Minority, and Women’s Business Enterprises (40 CFR, Part 33) in procurement under the DWSRF program. The goals for the utilization of disadvantaged businesses are as follows:

Construction	10% MBE	6% WBE
Supplies	8% MBE	4% WBE
Equipment	8% MBE	4% WBE
Purchased Services	10% MBE	4% WBE

All general contractors and subcontractors must accept the fair share objective/goals stated above and attest to the fact they are purchasing the same or similar construction, supplies, services, and equipment, in the same or similar relevant geographic buying market as the Washington Office of Minority Women Business goals.

The DWSRF program exempts borrowers that receive a total of \$250,000 or less in EPA funds in a given fiscal year from the Fair Share Objective requirements.

IMPORTANT: Only MBEs and WBEs certified by EPA, SBA, DOT, or by state, local, tribal or private entities whose certification criteria match EPA’s can be counted towards the MBEs and WBEs utilization goal.

MBE/WBE Reporting (40 CFR Part 33 Parts 33.302, 33.502 and 33.503). (suspended)

The contractor shall provide EPA Form 6100-2 DBE Subcontractor Participation Form to all DBE subcontractors. Subcontractors may submit EPA Form 6100-2 Subcontractor Participation Form to the EPA Region 10 DBE coordinator in order to document issues or concerns with their usage or payment for a subcontract. The contractor shall require all DBE subcontractors to complete EPA Form 6100-3 DBE Subcontractor Performance Form. The contractor shall complete EPA Form 6100-4 DBE Subcontractor Utilization Form.

The contractor shall submit EPA Form 6100-4 and all completed EPA Form 6100-3 forms with the bid proposal.

Bidders List (40 CFR Part 33 part 33.501)

All bidders shall submit the following information for all firms that bid or quote on subcontracts (including both DBE and non-DBE firms) with their bid proposal.

1. Entity's name with point of contact;
2. Entity's mailing address, telephone number, and e-mail address;
3. The procurement on which the entity bid or quoted, and when; and,
4. Entity's status as an MBE/WBE or non-MBE/WBE



Contract Administration Provisions (40 CFR part 33.302).

The contractor shall comply with the contract administration provisions of 40 CFR, Part 33.302.

1. The contractor shall pay its subcontractor for satisfactory performance no more than 30 days from the contractor's receipt of payment.
2. The contractor shall notify the owner in writing prior to any termination of a DBE subcontractor.
3. If a DBE subcontractor fails to complete work under the subcontract for any reason, the contractor shall employ the six good faith efforts when soliciting a replacement subcontractor.
4. The contractor shall employ the six good faith efforts even if the contractor has achieved its fair share objectives.



Third Party Beneficiary

The Washington State Department of Health Drinking Water State Revolving Fund is providing partial funding for this project. All parties agree that Washington State shall be, and is hereby, named as an express third-party beneficiary of this contract, with full rights as such.

Access to the Construction Site and to Records

The contractor shall provide Washington State Department of Health and U.S. Environmental Protection Agency personnel safe access to the construction site and to the contractor's records.

The contractor shall maintain accurate records and accounts to facilitate the owner's audit requirements and shall ensure that all subcontractors maintain auditable records.

These project records shall be separate and distinct from the contractor's other records and accounts.

All such records shall be available to the owner and to Washington State Department of Health and EPA personnel for examination. The contractor must retain all records pertinent to this project for three years after the final audit.

Attachments:

1. Wage Rate Requirements for Subrecipients
 - a. Attachment 1A for municipal borrowers
2. Current Wage Rate Determination (Verified by Contract Manager)

3. Certification Of Non-segregated Facilities
4. Notice To Labor Unions Or Other Organization Of Workers: Non-Discrimination In Employment
5. American Iron and Steel Requirements – The Use of American Iron and Steel



WAGE RATE REQUIREMENTS FOR SUBRECIPIENTS

The following terms and conditions specify how recipients will assist EPA in meeting its Davis-Bacon Act responsibilities when the act applies to EPA awards of financial assistance with respect to government recipients and subrecipients. If a subrecipient has questions about when the act applies, how to obtain correct wage determinations, act provisions, or compliance monitoring, it may contact DOH.

1. Applicability of the Davis-Bacon (DB) prevailing wage requirements

Under the FY 2013 Continuing Resolution, Davis-Bacon prevailing wage requirements apply to construction, alteration, and repair of treatment works carried out in whole or in part with assistance from a state water pollution control revolving fund and to any construction project carried out in whole or in part by assistance from a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the state recipient before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Before issuing requests for bids, proposals, quotes or other methods for soliciting contracts, subrecipients shall obtain the wage determination for the locality where a covered activity subject to DB will take place. Subrecipients must submit the wage determination to Department of Health before inserting it into a solicitation or contract, or issuing task orders, work assignments or similar instruments to existing contractors unless the state recipient provides other directions. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring subcontractors to follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipient shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days before the closing date, the subrecipient may ask the state recipient whether there is reasonable time to notify interested contractors of the modified wage determination. The state recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days after closing the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the state recipient obtains, at the subrecipient's request, an extension of the 90 day period from DOL (29 CFR 1.6(c)(3)(iv)). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(c) Subrecipients shall review all subcontracts subject to DB that prime contractors enter into to verify that the prime contractor required its subcontractors to include the applicable wage determinations.

(d) If DOL determines that the subrecipient failed to incorporate a wage determination or used a wage determination that clearly doesn't apply to the contract or ordering instrument, it may issue a revised wage determination after the subrecipient awarded the contract or issued an ordering instrument (29 CFR 1.6(f)). If this occurs, the subrecipient must either terminate and issue a revised contract or ordering instrument, or use a change order to incorporate DOL's wage determination into the contract or ordering instrument retroactive to the beginning. . The subrecipient must compensate its contractor for any wage increases resulting from DOL's revised wage determination.

ATTACHMENT 1A

LABOR STANDARDS PROVISIONS

MUNICIPAL BORROWERS

Contract and Subcontract provisions.

(a) The recipient must ensure that subrecipient(s) insert the following clauses in full in any contract in excess of \$2,000 entered for the actual construction, alteration or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from federal funds, or according to guarantees of a federal agency or financed from funds obtained by pledge of any contract of a federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2013 Continuing Resolution:

(1) Minimum wages.

(i) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in § 5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: Provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor

and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

Subrecipients may obtain wage determinations from the U.S. Department of Labor at www.dol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The state award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

- (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
- (2) The classification is utilized in the area by the construction industry; and
- (3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the subrecipient(s) agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), documentation of the action taken and the request, including the local wage determination shall be sent by the subrecipient(s) to the state award official. The state award official will transmit the request, to the administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210 and to the EPA DB Regional Coordinator concurrently. The administrator, or an authorized representative, will approve, modify, or disapprove every additional classification request within 30 days of receipt and so advise the state award official or will notify the state award official within the 30-day period that additional time is necessary.

(C) If the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the subrecipient(s) do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the award official shall refer the request and the local wage determination, including the views of all interested parties and the recommendation of the State award official, to the Administrator for determination. The request shall be sent to the EPA DB Regional Coordinator concurrently. The administrator, or an authorized representative, will issue a determination within 30 days of receipt of the request and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

(D) The wage rate (including fringe benefits where appropriate) determined pursuant to paragraphs (a)(1)(ii)(B) or (C) of this section, shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor

shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(2) Withholding. The subrecipient(s), shall upon written request of the EPA award official or an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor under this contract or any other federal contract with the same prime contractor, or any other federally-assisted contract subject to Davis-Bacon prevailing wage requirements, which is held by the same prime contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the (Agency) may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(3) Payrolls and basic records.

(i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b) (2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii) (A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the state capitalization grant recipient. Such documentation shall be available on request of the state recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the state indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division website at dol.gov/whd/forms/wh347instr or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the state or EPA if requested by the EPA, the state, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

(B) Each payroll submitted shall be accompanied by a "Statement of Compliance" signed by the contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) That the payroll for the payroll period contains the information required to be provided under § 5.5 (a)(3)(ii) of Regulations, 29 CFR part 5, the appropriate information is being maintained under § 5.5 (a)(3)(i) of Regulations, 29 CFR part 5, and that such information is correct and complete;

(2) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in Regulations, 29 CFR part 3;

(3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the state, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the federal agency or state may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees.

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a state Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a state Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. If the Office of Apprenticeship Training, Employer and Labor Services, or a state Apprenticeship Agency it recognizes, withdraws approval of an apprenticeship program, the

contractor will no longer be permitted to use apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits according to the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. IF the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(iii) Equal employment opportunity. The utilization of apprentices, trainees and journeymen under this part shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR part 30.

(5) Compliance with Copeland Act requirements. The contractor shall comply with the requirements of 29 CFR part 3, which are incorporated by reference in this contract.

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

(7) Contract termination; debarment. A breach of the contract clauses in 29 CFR 5.5 may be grounds for termination of the contract, and for debarment as a contractor and a subcontractor as provided in 29 CFR 5.12.

(8) Compliance with Davis-Bacon and Related Act requirements. All rulings and interpretations of the Davis-Bacon and Related Acts contained in 29 CFR parts 1, 3, and 5 are herein incorporated by reference in this contract.

(9) Disputes concerning labor standards. Disputes arising out of the labor standards provisions of this contract shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the Department of Labor set forth in 29 CFR parts 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and Subrecipient(s), state, EPA, the U.S. Department of Labor, or the employees or their representatives.

(10) Certification of eligibility.

- (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- (ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a government contract by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).
- (iii) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

4. Contract Provision for Contracts in Excess of \$100,000.

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

- (1) Overtime requirements. No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers or mechanics shall require or permit any such laborer or mechanic in any workweek in which he or she is employed on such work to work in excess of 40 hours in such workweek unless such laborer or mechanic receives compensation at a rate not less than one and one-half times the basic rate of pay for all hours worked in excess of 40 hours in such workweek.
- (2) Violation; liability for unpaid wages; liquidated damages. In the event of any violation of the clause set forth in paragraph (a)(1) of this section the contractor and any subcontractor responsible therefore shall be liable for the unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchmen and guards, employed in violation of the clause set forth in paragraph (a)(1) of this section, in the sum of \$10 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of 40 hours without payment of the overtime wages required by the clause set forth in paragraph (a)(1) of this section.

- (3) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the EPA award official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any monies payable on account of work performed by the contractor or subcontractor under any such contract or any other federal contract with the same prime contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.
- (4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.
- (b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

- (a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.
- (b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicated that there is a risk that the contractor or subcontractor is not complying with DB.

Subrecipients shall, "immediately conduct interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence."

- (c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.
- (d) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.
- (e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at dol.gov/contacts/whd/america2.

ATTACHMENT 2

FEDERAL & STATE WAGE RATE DETERMINATIONS

[DWSRF assistance recipient to insert applicable wage determinations here. Your DWSRF contract manager must verify your wage determination.]

ATTACHMENT 4
NOTICE TO LABOR UNIONS OR OTHER ORGANIZATION OF WORKERS: NON-DISCRIMINATION IN EMPLOYMENT

TO: _____
(name of union or organization of worker)

The undersigned currently holds contract(s) with _____
(name of applicant)

involving funds or credit of the U.S. Government or (a) subcontract(s) with a prime contractor holding such contract(s).

You are advised that under the provisions of the above contract(s) or subcontract(s) and according to Section 202 of Executive Order 11246 dated September 24, 1965, the undersigned is obliged not to discriminate against any employee or applicant for employment because of race, color, creed, or national origin. This obligation not to discriminate in employment includes, but is not limited to, the following:

EMPLOYMENT, UPGRADING, TRANSFER OR DEMOTION

RECRUITMENT AND ADVERTISING

RATES OF PAY OR OTHER FORMS OF COMPENSATION

SELECTION FOR TRAINING INCLUDING APPRENTICESHIP, LAYOFF OR TERMINATION

This notice is furnished to you pursuant to the provisions of the above contract(s) or subcontract(s) and Executive Order 11246.

The undersigned will post copies of this notice in conspicuous places available to employees or applicants for employment.

(Contractor or Subcontractor(s))

(Date)

ATTACHMENT 5

AMERICAN IRON AND STEEL PROVISION

USE OF AMERICAN IRON AND STEEL

MUST BE INCLUDED IN ALL CONTRACTS (PRIME AND SUB-CONTRACTORS):

This provision applies to projects for the construction, alteration, maintenance, or repair of a public water system as defined in the Safe Drinking Water Act (42 U.S.C 300j-12). This provision does not apply if the Department of Health approved the engineering plans and specification for the project prior to January 17, 2014.

The contractor acknowledges to and for the benefit of the project owner and Washington State that she or he understands that the Drinking Water State Revolving Loan Fund is paying for the goods and services under this agreement. DWSRF contains provisions, commonly known as “Buy American;” that requires all iron and steel products used in the project be produced in the United States (American Iron and Steel Requirements). The act defines iron and steel products as, “...the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.”

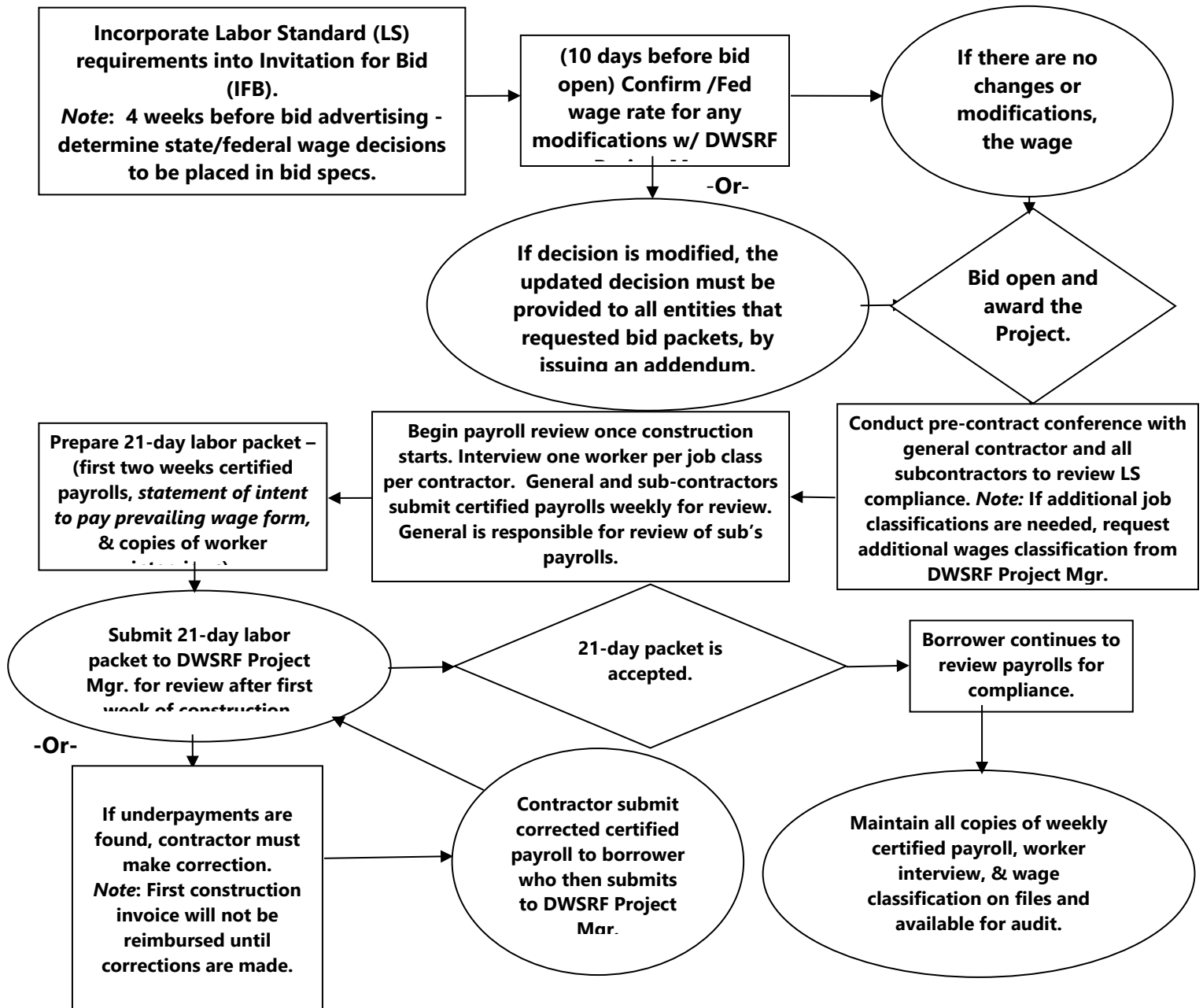
The contractor hereby represents and warrants to and for the benefit of the project owner and the state that:

- a) The contractor has reviewed and understands the American Iron and Steel Requirements,
- b) All of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirements, unless a waiver of the requirements is approved, and
- c) The contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirements, as may be requested by the project owner or the state.

Notwithstanding any other provisions of this agreement, any failure to comply with this paragraph by the contractor shall permit the project owner or state to recover as damages against the contractor any loss, expense or cost (including without limitation attorney’s fees) incurred by the project owner or state resulting from any such failure (including without limitation any impairment or loss of funding, whether in whole or part, from the state or any damages owed to the state by the project owner). While the contractor has no direct contractual obligation with the state, as a lender to the project owner for the funding of its project, the project owner and the contractor agree that the state is a third-party beneficiary and neither this paragraph nor any other provision of the agreement necessary to give this paragraph force or effect shall be amended or waived without the prior written consent of the state.

Attachment 7-F: Davis-Bacon Flow Chart

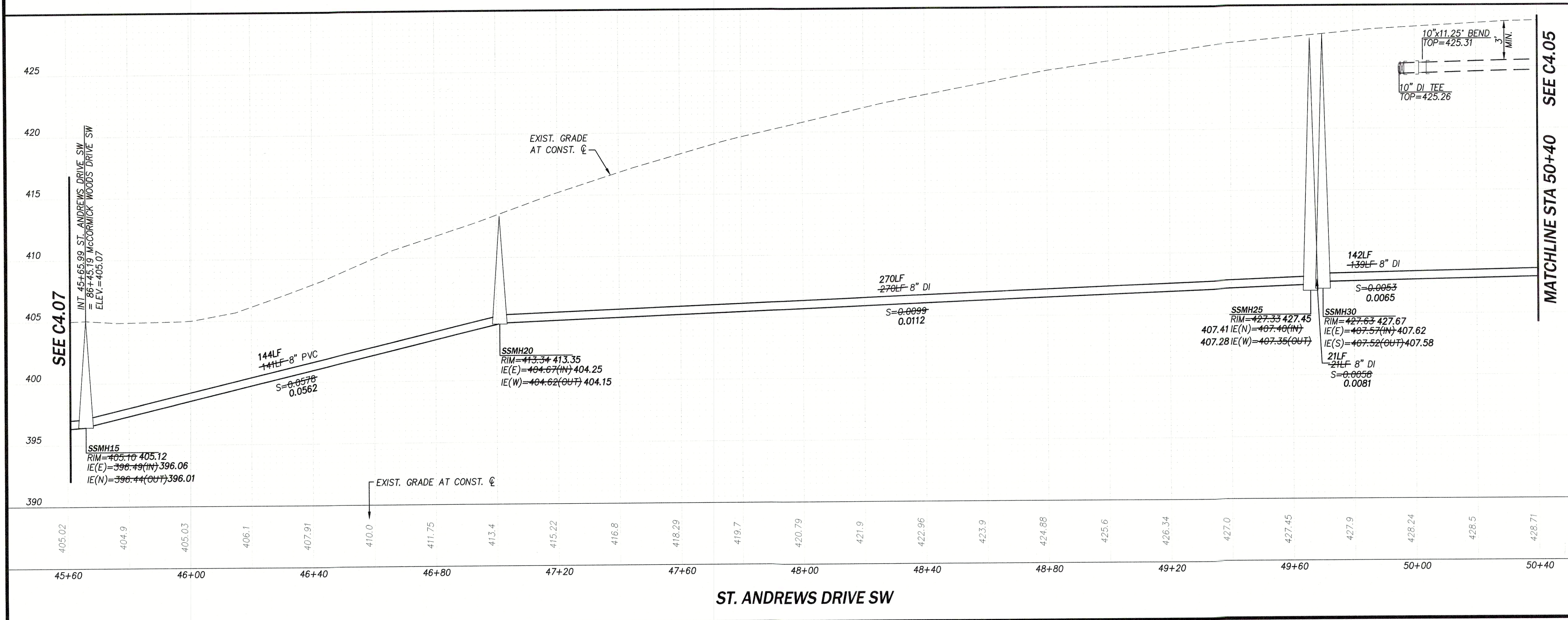
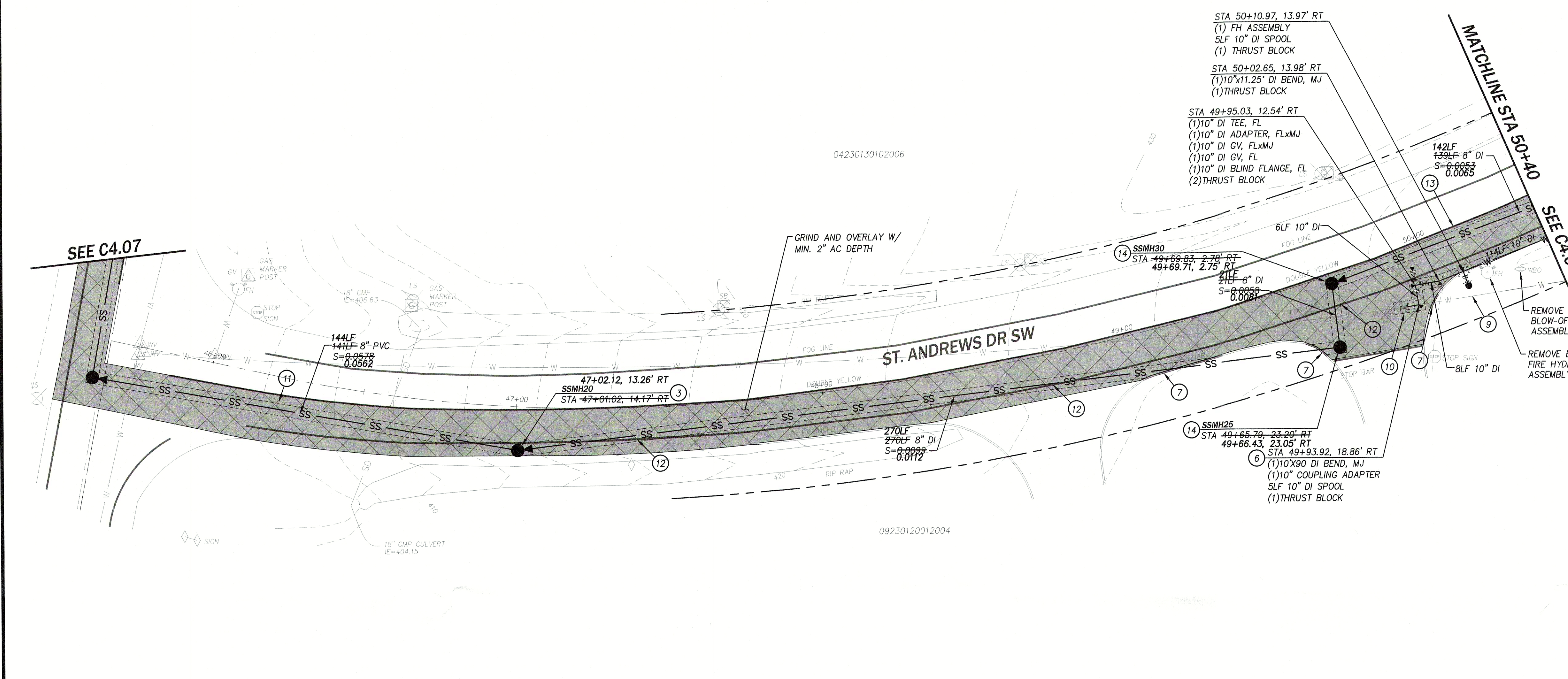
Disclaimer: This is a summarization of the Davis-Bacon process and does not guarantee compliance with all requirements. Borrowers, prime contractors, and sub-contractors are responsible for compliance with all the rules and guidelines as required by the Davis-Bacon Act as enacted in the laws. DOH expressly disclaims any warranty related to the compliance with the Davis-Bacon requirements and will accept no responsibility for any consequences arising from the use or reliance on this Flow Chart.



APPENDIX D
ASBUILTS

A PORTION OF THE NW 1/4 OF THE NE 1/4 & THE SE 1/4 OF THE NE 1/4 & THE NE 1/4 OF THE NW 1/4 OF SEC. 09, TWP. 23N., RNG. 1E. W.M.

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CS#791712
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CUWS#791712
KEYMAP
TBLOCK-WS

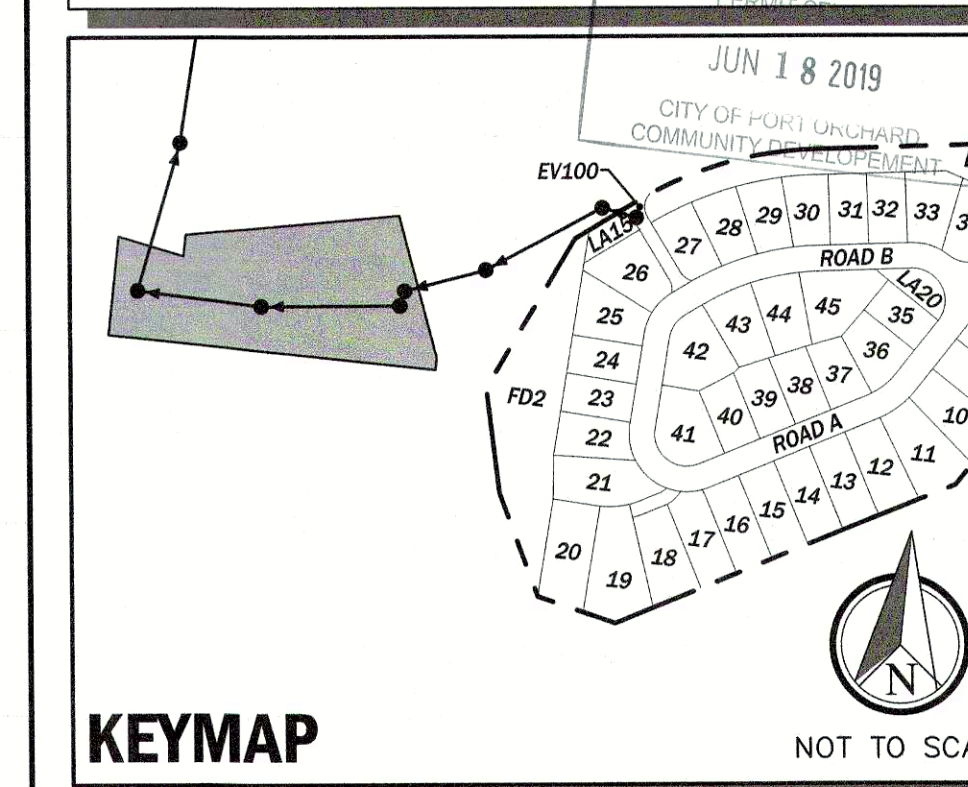


CONSTRUCTION NOTES

- ① 6" SINGLE SEWER SERVICE CONNECTION W/CLEANOUT AT LOT CONN. PER COPO STD. DWG. NO. 1241. SEE NOTE 1; INVERT ELEV. AT LOT CONN. PER SEWER SERVICE SCHED.
- ② SEWER SERVICE CONNECTION MARKER, SEE NOTE 5
- ③ 48" SANITARY SEWER MANHOLE PER COPO STD. DWG. NO. 1220 W/TYP. TOP SECTIONS AND CHANNELIZATION PER COPO STD. DWG. NO. 1222
- ④ 3/4" x 3/8" WATER SERVICE PER COPO STD. DWG. NO. 1160, MAINTAIN 2" BETWEEN SADDLE TAPS
- ⑤ FIRE HYDRANT ASSEMBLY PER DETL. ON SHT. C4.00; SEE NOTE 6
- ⑥ CONN. TO EXIST. WATER MAIN. VERIFY LOCATION IN FIELD
- ⑦ REMOVE AND REPLACE EXIST. DUAL-FACED CEMENT CONC. TRAFFIC CURB TO NEAREST JOINT PER WSDOT STD. PLAN F-10.12-03
- ⑧ 48" SANITARY SEWER SADDLE MANHOLE PER COPO STD. DWG. NO. 1223 W/TYP. TOP SECTIONS PER COPO STD. DWG. NO. 1222; VERIFY LOCATION AND DEPTH OF EXIST. SEWER MAIN
- ⑨ ABANDON PORTION EXIST. WATER MAIN PER COPO PUBLIC WORKS STANDARDS
- ⑩ WATER MAIN TRENCH RESTORATION PER COPO STD. DWG. NO. 1101
- ⑪ SEWER TRENCH RESTORATION PER COPO STD. DWG. NO. 1200
- ⑫ REPLACE 4" WHITE PAINTED LINE, TYPE "T" PER COPO STD. DWG. NO. 621
- ⑬ REPLACE 4" DOUBLE YELLOW PAINT STRIPE, MEDIAN PATTERN PER COPO STD. DWG. NO. 622, SEE NOTE 8
- ⑭ MANHOLE DETAIL FOR MANHOLES GREATER THAN 15' DEEP PER DETL. ON SHT. C4.100

NOTES:

1. SIDE SEWER SERVICES SHALL BE INSTALLED WITH A MINIMUM 2% SLOPE FROM MAIN TO LOT CONNECTION. LOT CONNECTION INVERT ELEVATION SHALL BE A MINIMUM 3.5 FEET BELOW BEARING PAD ELEVATION (APPROX. 5 FEET BELOW FINISHED FLOOR ELEVATION) UNLESS NOTED OTHERWISE ON PLAN.
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5. ALL SANITARY SEWER SERVICE CONNECTIONS SHALL EXTEND 10 FEET BEYOND THE PROPERTY LINE AND TERMINATE ON THE LOT WITH A TYPICAL SERVICE CONNECTION MARKER PER CITY OF PORT ORCHARD STANDARD DRAWING NOS. 1241 AND 1243.
6. HYDRANT ASSEMBLIES EXTENDING MORE THAN 18 FEET FROM THE MAIN LINE TEE SHALL BE INSTALLED WITH A TIE-BACK ANCHOR SECURED TO THE TEE AT THE WATER MAIN. HYDRANT ASSEMBLIES EXTENDED LESS THAN 18 FEET FROM THE MAIN SHALL INCLUDE TWO EACH GALVANIZED THREADED RODS SECURED FROM THE HYDRANT TO THE FLANGE OF THE MAIN LINE TEE. ALL HYDRANT ASSEMBLIES SHALL BE INSTALLED WITH MEGA-LUG RESTRAINTS AT ALL MECHANICAL JOINTS.
7. FIELD-LOK GASKETS SHALL BE USED FOR ALL DUCTILE IRON PIPE RESTRAINED JOINTS UNLESS OTHERWISE NOTED OR APPROVED BY CITY INSPECTOR.
8. "TYPE 2D LANE MARKER" SHALL NOT BE INSTALLED.

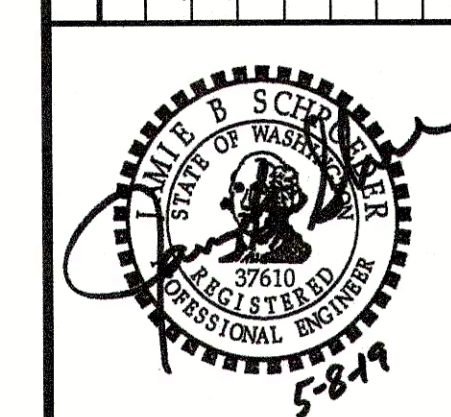


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Know what's below.
Call before you dig.

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NO.	DATE	REVISION	BY	CHK.
1	7/09/18	SUBMITTAL	BBB	BBB
2	8/31/18	WATER FITTINGS REVISION	MRL	BBB
3	5/9/19	RECORD DRAWINGS	MRL	BBB



THE AS-BUILT INFORMATION SHOWN ON THIS PLAN IS PER A FIELD SURVEY PERFORMED AND DATA PROVIDED CONTOUR ENGINEERING AND/OR RECORD INFORMATION PROVIDED BY THE CONTRACTOR.

MCCORMICK WOODS - PARCEL C
RIGHT-OF-WAY
OFFSITE SANITARY SEWER PLAN AND PROFILE
CITY OF PORT ORCHARD
KITSAP COUNTY/WASHINGTON

CLIENT
MCCORMICK COMMUNITIES, INC
GREG KRABBE
805 KIRKLAND AVE, SUITE 200
KIRKLAND, WA 98033

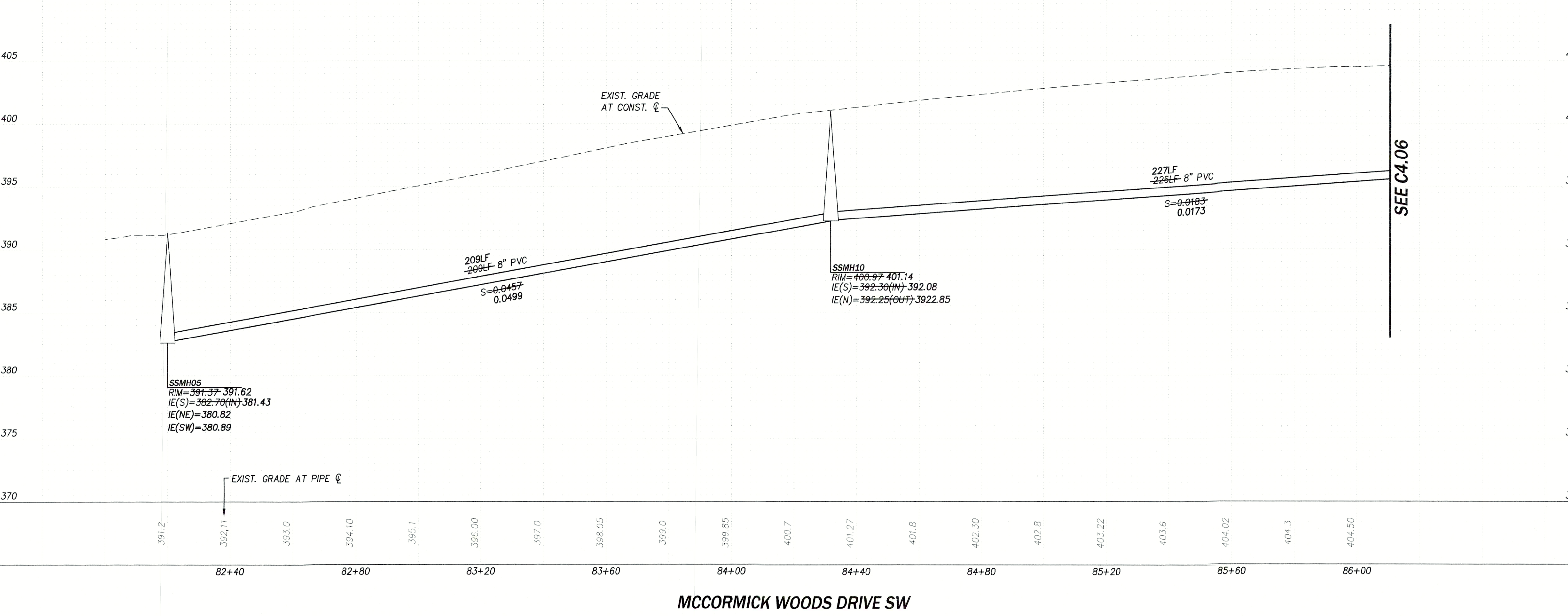
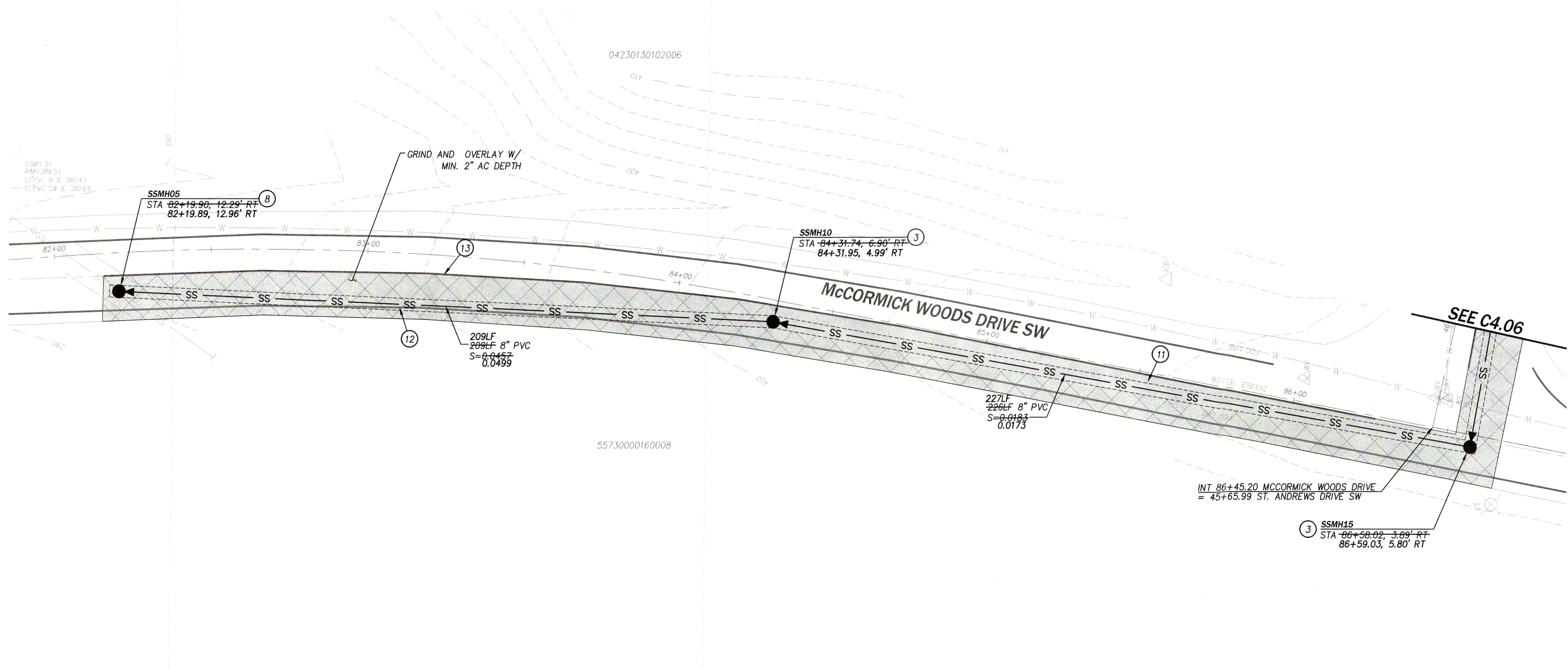
CPH CONSULTANTS
Site Planning • Civil Engineering
Land Use Consulting • Project Management
14431 Willows Rd., NE, Suite 120
Redmond, WA 98052
Phone: (425) 285-2390 | FAX: (425) 285-2389
www.cphconsultants.com

PROJECT NO.
0079-17-012
DRAWING
C4.06
SHEET 3 OF 6

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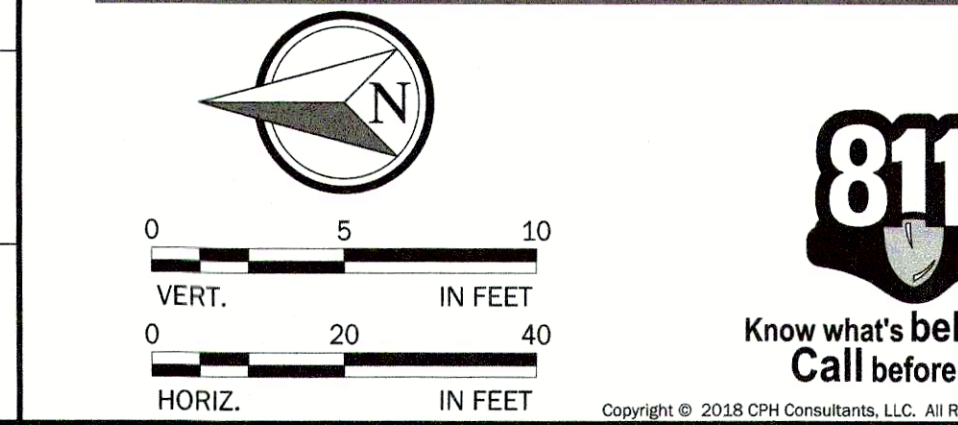
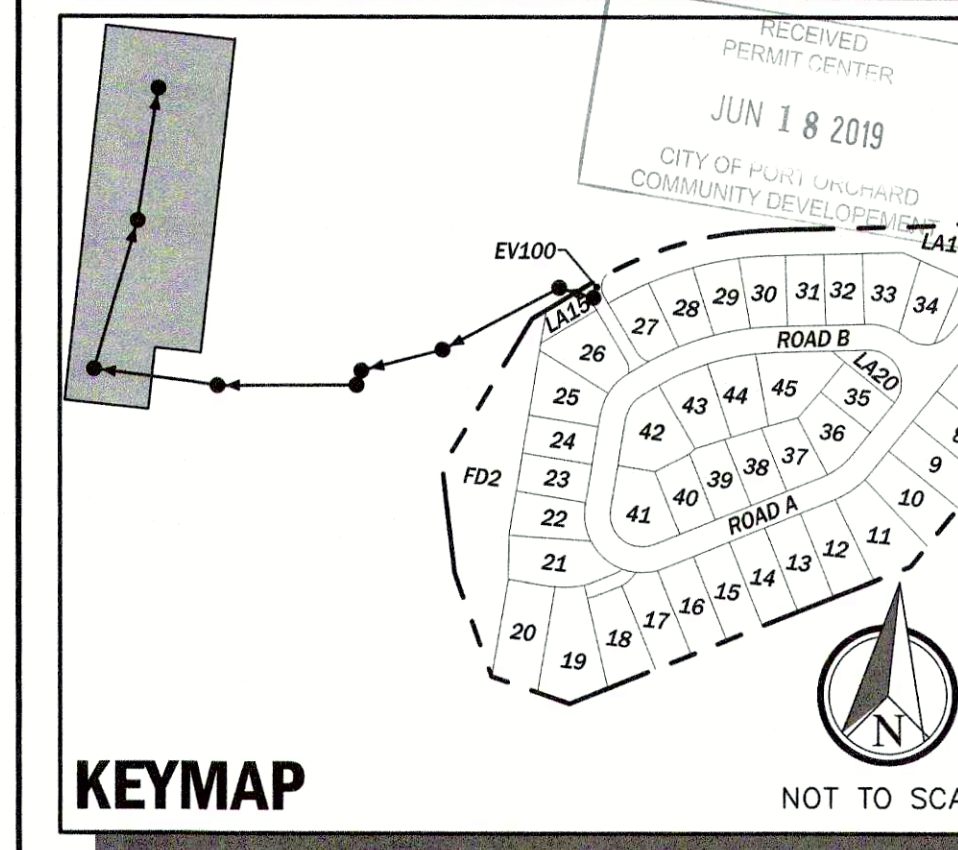
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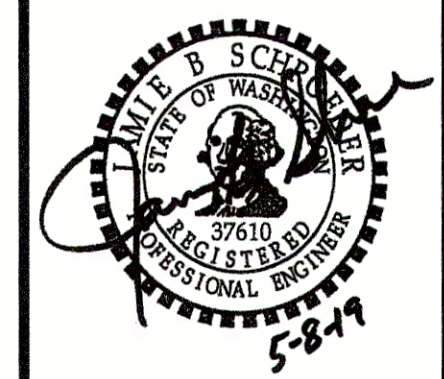
CONSTRUCTION NOTES

- ① 6" SINGLE SEWER SERVICE CONNECTION W/CLEANOUT AT LOT CONN. PER COPO STD. DWG. NO. 1241, SEE NOTE 1; INVERT ELEV. AT LOT CONN. PER SEWER SERVICE SCHED.
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NO.	DATE	REVISION	BY	CHK.
1	7/09/18	SUBMITTAL	PCE	BHB
2	8/31/18	SSMH15 LABEL REVISION	MRL	BHB
3	5/01/19	RECORD DRAWINGS	MRL	BHB



THE AS-BUILT INFORMATION SHOWN ON THIS PLAN IS PER A FIELD SURVEY PERFORMED AND DATA PROVIDED AND/OR RECORD INFORMATION PROVIDED BY THE CONTRACTOR.

MCCORMICK WOODS - PARCEL C
 RIGHT-OF-WAY
 OFFSITE SANITARY SEWER PLAN AND PROFILE

CLIENT
 McCORMICK COMMUNITIES, INC
 GREG KRABBE
 805 KIRKLAND AVE, SUITE 200
 KIRKLAND, WA 98033

PROJECT NO.
 0079-17-012

DRAWING
 C4.07

SHEET 4 OF 6
 PN16 002

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 5/9/2019 9:27 AM PETER EVANS

APPENDIX E
DAVIS BACON ACT WAGE DETERMINATION

"General Decision Number: WA20230071 01/06/2023

Superseded General Decision Number: WA20220071

State: Washington

Construction Type: Heavy
Including water and sewer line construction

County: Kitsap County in Washington.

HEAVY CONSTRUCTION PROJECTS (including sewer/water construction).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(2)-(60).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	<ul style="list-style-type: none">. Executive Order 14026 generally applies to the contract.. The contractor must pay all covered workers at least \$16.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2023.
If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	<ul style="list-style-type: none">. Executive Order 13658 generally applies to the contract.. The contractor must pay all covered workers at least \$12.15 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2023.

Zone Pay:

0 -25 radius miles	Free
26-45 radius miles	\$.70/hour
Over 45 radius miles	\$1.50/hour

ELEC0046-006 08/01/2022

	Rates	Fringes
ELECTRICIAN.....	\$ 65.72	26.87

ENGI0302-027 06/01/2022

	Rates	Fringes
Power equipment operators:		
Group 1A.....	\$ 54.20	24.47
Group 1AA.....	\$ 54.98	24.47
Group 1AAA.....	\$ 55.78	24.47
Group 1.....	\$ 53.40	24.47
Group 2.....	\$ 52.72	24.47
Group 3.....	\$ 52.12	24.47
Group 4.....	\$ 48.78	24.47

Zone Differential (Add to Zone 1 rates):
 Zone 2 (26-45 radius miles) - \$1.00
 Zone 3 (Over 45 radius miles) - \$1.30

BASEPOINTS: Aberdeen, Bellingham, Bremerton, Everett, Kent,
 Mount Vernon, Port Angeles, Port Townsend, Seattle,
 Shelton, Wenatchee, Yakima

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-over 300 tons, or 300 ft of boom
 (including jib with attachments)

GROUP 1AA - Cranes 200 to 300 tons, or 250 ft of boom
 (including jib with attachments); Tower crane over 175 ft in
 height, base to boom; Excavator/Trackhoe: Over 90 metric
 tons

GROUP 1A - Cranes, 100 tons thru 199 tons, or 150 ft of boom
 (including jib with attachments); Crane-overhead, bridge
 type, 100 tons and over; Tower crane up to 175 ft in height
 base to boom; Loaders-overhead, 8 yards and over;
 excavator/Trackhoe: over 50 metric tons to 90 metric tons;

GROUP 1 - Cranes 45 tons thru 99 tons, under 150 ft of boom

(including jib with attachments);Crane-overhead, bridge type, 45 tons thru 99 tons; Derricks on building work; Excavator/Trackhoe: over 30 metric tons to 50 metric tons; Loader- overhead 6 yards to, but not including 8 yards; Dozer D-10; Screedman; Scrapers: 45 yards and over; Grader/Blade; Paver

GROUP 2 - Cranes, 20 tons thru 44 tons with attachments;Crane-overhead, bridge type-20 tons through 44 tons; Drilling machine; Excavator/Trackhoe: 15 to 30 metric tons; Horizontal/directional drill operator; Loaders-overhead under 6 yards; Scraper: under 45 tons; Mechanic; Piledriver; Boring Machine

GROUP 3 - Cranes-thru 19 tons with attachments;A-frame crane over 10 tons; Dozers-D-9 and under; Motor patrol grader-nonfinishing; Roller-Plant Mix; Excavator/Trackhoe: under 15 metric tons; Service Oiler; Forklift: 3,000 lbs and over with attachments; Boom Truck over 10 tons

GROUP 4 - Cranes-A frame-10 tons and under; Roller-other than plant mix; Forklift: under 3,000 lbs with attachments Grade Checker; Drill Assistant; Boom Truck 10 tons and under

 IRON0086-010 07/04/2022

	Rates	Fringes
IRONWORKER (Reinforcing, Structural and Ornamental).....	\$ 49.90	31.82

 LAB00252-009 06/01/2022

	Rates	Fringes
Laborers:		
GROUP 2.....	\$ 34.20	13.80
GROUP 3.....	\$ 42.86	13.80
GROUP 4.....	\$ 43.90	13.80
GROUP 5.....	\$ 44.62	13.80

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):
 ZONE 2 - \$1.00
 ZONE 3 - \$1.30

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT, SEATTLE, KENT, TACOMA, OLYMPIA, CENTRALIA, ABERDEEN, SHELTON, PT. TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective city hall
 ZONE 2 - More than 25 but less than 45 radius miles from the respective city hall
 ZONE 3 - More than 45 radius miles from the respective city hall

LABORERS CLASSIFICATIONS

GROUP 2: Flagman

GROUP 3: General Laborer; Form Stripping

GROUP 4: Pipe Layer; Handheld Drill; Jackhammer

GROUP 5: Mason Tender-Brick; Mason Tender-Cement/Concrete; Grade Checker; High Scaler;

 PAIN0005-008 07/01/2022

	Rates	Fringes
PAINTER (Brush, Roller and Spray).....	\$ 28.41	14.50

 PLAS0528-004 06/01/2022

	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER....	\$ 50.00	19.59

 TEAM0174-006 06/01/2019

	Rates	Fringes
Truck drivers:		
ZONE A:		
GROUP 1:.....	\$ 40.38	20.46
GROUP 2:.....	\$ 39.54	20.46

ZONE B (25-45 miles from center of listed cities*): Add \$.70 per hour to Zone A rates.
 ZONE C (over 45 miles from centr of listed cities*): Add \$1.00 per hour to Zone A rates.

*Zone pay will be calculated from the city center of the following listed cities:

BELLINGHAM CENTRALIA RAYMOND OLYMPIA

EVERETT	SHELTON	ANACORTES	BELLEVUE
SEATTLE	PORT ANGELES	MT. VERNON	KENT
TACOMA	PORT TOWNSEND	ABERDEEN	BREMERTON

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1 - Water Truck-3,000 gallons and over; Semi-Trailer Truck

GROUP 2 - Water Truck- less than 3,000 gallons

HAZMAT PROJECTS

Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium, in addition to the classification working in as follows:

LEVEL C: +\$.25 per hour - This level uses an air purifying respirator or additional protective clothing.

LEVEL B: +\$.50 per hour - Uses same respirator protection as Level A. Supplied air line is provided in conjunction with a chemical "splash suit."

LEVEL A: +\$.75 per hour - This level utilizes a fully-encapsulated suit with a self-contained breathing apparatus or a supplied air line.

 SUWA2009-062 08/07/2009

	Rates	Fringes
LABORER: Landscape & Irrigation.....	\$ 13.52 **	3.35
OPERATOR: Asphalt Plant.....	\$ 34.14	0.68
OPERATOR: Backhoe.....	\$ 27.86	6.92
OPERATOR: Broom/Sweeper.....	\$ 30.39	3.77
OPERATOR: Power Shovel.....	\$ 25.12	7.83
OPERATOR: Skid Steer.....	\$ 10.63 **	0.00
OPERATOR: Loader.....	\$ 26.46	7.94
TRUCK DRIVER, Includes Dump Truck.....	\$ 25.75	8.38
TRUCK DRIVER: Flatbed Truck.....	\$ 22.74	6.29

TRUCK DRIVER: Lowboy Truck.....\$ 22.89 5.72

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$16.20) or 13658 (\$12.15). Please see the Note at the top of the wage determination for more information.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date

for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the

interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISIO"