

**CITY OF COTTAGE GROVE  
CONTRACT DOCUMENTS  
FOR  
SECONDARY CLARIFIER 1 REHABILITATION**

**JOB NO. 23-1072**

**Project Administrated by**



Candace Solesbee – Mayor

City Council

Chalice Savage  
John Stinnett  
Dana Merryday

Mike Fleck  
Alex Dreher  
Greg Ervin

**March 2023**

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CITY OF COTTAGE GROVE  
CONTRACT DOCUMENTS  
FOR  
SECONDARY CLARIFIER 1 REHABILITATION

**DESIGN CERTIFICATION**

The Technical Specifications contained herein have been prepared by, or under the responsible charge of, the following registered person(s):

**West Yost Associates**

Walter J. Meyer, PE

License # 10945PE



EXPIRES : 12/31/2024

**West Yost Associates**

Zane Edward Wilsterman

License # 10141PE



EXPIRES : 6/30/2024

**ACE Engineering**

Allan T. Goffe, PE SE

License # 64239PE



EXPIRES 6/30/2023

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CITY OF COTTAGE GROVE, OREGON  
CONTRACT DOCUMENTS  
FOR  
SECONDARY CLARIFIER 1 REHABILITATION

TITLE SHEET

VICINITY MAP

INDEX

ADVERTISEMENT FOR BIDS

INSTRUCTION TO BIDDERS

PROJECT BID

BID SCHEDULES

RESIDENT/NONRESIDENT BIDDER STATUS

CONTRACT FOR CONSTRUCTION

PERFORMANCE BOND

PAYMENT BOND

PUBLIC WORKS BOND

GENERAL CONDITIONS

- |   |                                      |
|---|--------------------------------------|
| 1 | DEFINITIONS                          |
| 2 | PLANS AND SPECIFICATIONS             |
| 3 | THE ENGINEER                         |
| 4 | THE CONTRACTOR                       |
| 5 | PROSECUTION AND PROGRESS OF THE WORK |
| 6 | PAYMENT FOR THE WORK                 |

PREVAILING WAGE RATES

SPECIAL PROVISIONS: GENERAL

- |      |  |
|------|--|
| G-01 | WORK INVOLVED                                    |
| G-02 | COMMENCEMENT AND COMPLETION OF WORK              |
| G-03 | FAILURE TO COMPLETE WORK IN THE TIME AGREED UPON |
| G-04 | PERIODIC PAYMENTS                                |
| G-05 | SPECIFICATIONS AND PLANS                         |
| G-06 | SUBCONTRACTORS                                   |
| G-07 | SUPERINTENDENCE                                  |
| G-08 | WORK LIMITS                                      |
| G-09 | SCHEDULE AND COORDINATION OF WORK                |
| G-10 | TRAFFIC CONTROL AND DETOURS DURING CONSTRUCTION  |
| G-11 | CONTRACTOR'S TRAFFIC AND MATERIALS DELIVERY      |
| G-12 | CONSTRUCTION WATER                               |
| G-13 | DAMAGE TO PROPERTY                               |

G-14	PROTECTION OF WORK
G-15	DISPOSAL OF MATERIALS
G-16	INSPECTION AND TESTING
G-17	MATERIAL AT JOB SITE
G-18	CERTIFICATES OF COMPLIANCE
G-19	LINES AND GRADES
G-20	SANITARY FACILITIES
G-21	CHANGES AND EXTRA WORK
G-22	NOTICE OF POTENTIAL CLAIM
G-23	CITY'S RIGHT TO WITHHOLD CERTAIN AMOUNTS
G-24	ACCEPTANCE OF WORK AND FINAL PAYMENT
G-25	NO WAIVER OF LEGAL RIGHTS
G-26	FINAL GUARANTY
G-27	CERTIFICATE OF INSURANCE
G-28	EXCAVATION, TRENCHING AND SHORING
G-29	STORAGE AREAS AND RESTORATION

## **TECHNICAL SPECIFICATIONS:**

### DIVISION 1 – GENERAL REQUIREMENTS

01112	Site Conditions
01140	Work Sequence and Constraints
01200	Measurement and Payment
01310	Project Meetings
01320	Construction Schedule
01325	Field Engineering
01326	Photographs
01330	Submittals
01340	Requests for Information and Clarifications
01400	Construction Staking
01450	Testing and Inspections
01455	Special Tests and Structural Observations
01500	Construction Facilities and Utilities
01505	Mobilization and Demobilization
01560	Environmental Controls
01600	Materials and Equipment
01610	Seismic Anchorage and Bracing
01611	System Outage Request
01615	Wind Design Criteria
01735	Cutting and Patching
01740	Cleaning
01770	Contract Closeout Procedures
01780	Record Drawings
01782	Operations and Maintenance Information

01785	Warranties and Bonds
01786	Spare Parts
01810	Facility Start-Up and Commissioning
01820	Training
01825	Equipment and System Testing
01890	Restoration of Improvements
01999	Forms

## DIVISION 2 – SITEWORK

02081	Controlled Low Strength Material
02200	Site Preparation
02210	Subsurface Investigations
02240	Dewatering
02260	Controlled Low Strength Material
02300	Earthwork
02320	Trenching
02722	Aggregate Base Course Material
02953	Pavement Restoration

## DIVISION 3 – CONCRETE

03301	Cast-in-Place Concrete
03315	Concrete Repair
03600	Grout

## DIVISION 5 – METALS

05501	Anchor Bolts and Anchoring Devices
05520	Handrail
05530	Aluminum Grating

## DIVISION 09 – FINISHES

09900	Coating Systems
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## DIVISION 10 – SPECIALTIES

10020	Warning Signs
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## DIVISION 11 – EQUIPMENT

11000	General Requirements for Equipment
11002	Equipment Mounting
11060	Electric Motors
11338	Circular Secondary Clarifier Equipment

## DIVISION 15 – MECHANICAL

15050	Piping Systems
15060	Pipe Hangers and Supports
15097	Seismic Restraints for Piping
15110	General Requirements for Valves
15117	Pressure Relief Valves for Structures
15119	Miscellaneous Specialty Valves
15141	Steel Pipe
15162	Reinforced Concrete Pipe
15250	Pipe Insulation
15951	Testing Gravity Flow Pipelines
15996	Testing Pressure Piping

## DIVISION 16 – ELECTRICAL

16050	Electrical Work
16070	Hangers and Supports for Electrical Systems
16122	600 Volt Cable
16130	Raceways and Boxes for Electrical Systems
16132	Flexible Conduit
16133	Sealing Fittings
16136	Outlet Boxes
16140	Wiring Devices
16195	Identification for Electrical Systems
16411	Disconnect Switches
16423	Motor Control Centers
16450	Grounding and Bonding for Electrical Systems
16500	Exterior Lighting

## APPENDICES (Under separate Cover)

APPENDIX A: Record Drawings - City of Cottage Grove, Sewage Treatment Plant Improvements. Roger L. Sinclair Engineering, January 1983

APPENDIX B: Clear Stream Equipment Submittal

APPENDIX C: Past Geotechnical Reports

- Cottage Grove WWTP Improvements, Geotechnical Investigation, Foundation Engineering, Inc., February 2004
- Cottage Grove WWTP, Storage Pond, Revised Final Geotechnical Data Report, Shannon & Wilson, Inc., November 2019

## **ADVERTISEMENT FOR BIDS**

### **SECONDARY CLARIFIER 1 REHABILITATION**

Sealed bids will be received by the City of Cottage Grove, in the Office of Public Works, until 10:00 a.m. on Wednesday, April 5, 2023, for the construction of the SECONDARY CLARIFIER 1 REHABILITATION Project and will then and there be opened and publicly read aloud. Bid proposals received after the date and time fixed for opening will not be considered. No electronic or facsimile submittals will be accepted.

The project consists of the construction of the following work and all work incidental thereto, as set forth in the project plans and specifications. The work generally consists of replacement of the existing secondary clarifier equipment, new concrete center foundation and miscellaneous structural concrete repairs, replacement of the existing handrail, replacement of small diameter piping and associated structural, mechanical, electrical and instrumentation and control improvements.

The Project Manual including; Plans, Specifications, Agreement, and Bid Forms are available at the City of Cottage Grove's website <https://www.cottagegroveor.gov/> where they can be viewed and printed. Any Addenda will also be posted on the city's website <https://www.cottagegroveor.gov/>. All prospective bidders must be added to the Plan Holders List by sending an e-mail with company contact information to [engassistant@cottagegrove.org](mailto:engassistant@cottagegrove.org) with the project title in the subject line. Prospective bidders must be on the Plan Holders List for their bid to be considered. Bidders are responsible for checking the website for addenda and changes prior to submitting bid, however notification of Addenda issuance will be issued via e-mail to the addresses listed on the Plan Holders List. No hard copy of the bid documents will be available.

Bidders must be pre-qualified with the City of Cottage Grove in accordance with Oregon Revised Statutes (ORS) Chapter 279C.430 by submitting either a completed City of Cottage Grove Prequalification form or an Oregon Department of Transportation form on or before 5:00 p.m., Friday, March 17, 2023. Bidders must be prequalified in wastewater treatment facilities construction. City of Cottage Grove Prequalification forms are available at 400 East Main Street, Cottage Grove, Oregon 97424. You may pre-qualify with the Oregon Department of Transportation at 121 Transportation Building, Salem, Oregon 97310.

Notice is hereby given that this contract is for a Public Work, subject to ORS 279C.800 to 279C.870.

All bids must be sealed and plainly marked on the outside showing the name of the bidder: the project name: the date and time of bid opening: the words "sealed bid": and addressed to

Faye Stewart, City Engineer, 400 East Main Street, Cottage Grove, Oregon 97424.

A mandatory pre-bid will be held for this project on Thursday, March 16, 2023 at 1:00 p.m. at City Hall, followed by a site visit.

**CITY OF COTTAGE GROVE  
COTTAGE GROVE, OREGON**

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## INSTRUCTIONS TO BIDDERS

### SECONDARY CLARIFIER 1 REHABILITATION

#### 1. Form of Bid

All bids must be made upon the blank form of bid attached hereto, and must give prices for each item and aggregate amount for the work listed in the Bid Schedule.

The City of Cottage Grove reserves the right to reject any bid not in compliance with all prescribed public contracting procedures and requirements, including the requirement to demonstrate the bidder's responsibility under ORS 279C.375(3)(b) and may reject for good cause all bids after finding that doing so is in the public's interest.

The bidder shall sign his/her bid in the blank space provided therefore. Bids made by corporations or partnerships shall contain the name and address of such organization, together with the names and addresses of partners or officers. If the proposal is made by a corporation, it must be signed by one of the officers thereof; if made by a partnership, by one of the partners.

All bids must be submitted at the time and place, and in the manner prescribed in the "Advertisement for Bids".

No bid for this contract shall be received or considered by the City of Cottage Grove unless the bidder is registered and in good standing with the Construction Contractors Board, as required by ORS Chapter 701, or licensed by the State Landscape Contractors Board, as required ORS 671.530.

#### 2. Contract Documents

The contract documents under which awardee shall execute this work consists of the Advertisement for Bids, the Instructions to Bidders, Bid Security, the Proposal, the signed Contract, the Performance Bond, the Payment Bond, the Public Works Bond, General Conditions, the Special Provisions, the Technical Specifications, Insurance Certification, and signed addenda; all bound herewith.

Any person contemplating the submission of a bid and being in doubt as to the meaning or intent of said contract documents should request, in writing, that the City of Cottage Grove's Engineer provide a written interpretation thereof.

#### 3. Prevailing Wage Rates

The "Provisions of ORS 279C.800 to ORS 279C.870 relating to the prevailing wage rates will be complied with.

a. The hourly rate of wage to be paid by Contractor or any Subcontractor to workers in each trade or occupation required for the public works employed in the performance of the Contract shall not be less than the specified minimum rate of wage in accordance with ORS 279C.838 and ORS 279C.840.

b. The latest prevailing wage rates for public works contracts in Oregon are contained in the following publications: The July 1, 2022 Prevailing Wage Rates for Public Works Projects in Oregon. Such publications can be reviewed electronically at:

<https://www.oregon.gov/boli/WHD/PWR/July%202019/July%201%2c%202019%20PWR%20Rate%20Book.pdf>

and are hereby incorporated as part of the contract documents.

c. Contractor and all Subcontractors shall keep the prevailing wage rates for this Project posted in a conspicuous and accessible place in or about the project.

d. The City of Cottage Grove shall pay a fee to the Commissioner of the Oregon Bureau of Labor and Industries as provided in ORS 279C.825. The fee shall be paid to the Commissioner as required by the administrative rules adopted by the Commissioner.

e. If Contractor or any Subcontractor also provides for or contributes to a health and welfare plan or a pension plan, or both, for its employees on the Project, it shall post notice describing such plans in a conspicuous and accessible place in or about the Project. The notice shall contain information on how and where to make claims and where to obtain future information.

#### 4. Estimate of Quantities

The estimate of quantities of work to be done as given in the proposal, although stated with as much accuracy as possible, is approximate only and is assumed solely for the purpose of comparing bids.

The quantities on which payments will be made to the Contractor are to be determined by measurement of the work actually performed by the Contractor as specified in the contract documents.

The Owner reserves the right to increase or diminish the amount of any class of work as may be deemed necessary. At the Owner's sole option and if it is determined to be in the Owner's best interest, any one or more Bid Items may be deleted from the work without penalty to the Owner.

#### 5. Bid Security

Bids must be accompanied by a certified check on a bank in good standing or a bid bond issued by a surety company authorized to issue such bonds in Oregon in an amount not less than ten (10) percent of the total amount of the proposal submitted payable to the City of Cottage Grove. All checks and Bid Bonds excepting that of the successful bidder will be returned within thirty (30) days after the contract has been awarded. The bid security of the successful bidder will be retained until he/she has entered into a satisfactory contract with the Owner. In addition, a Performance Bond will be required in the full amount of the contract and a Payment Bond will be required in the full amount of the contract in accordance with ORS 279C.380.

#### 6. Conditions of Work

It is understood that the Contractor, before submitting his/her bid, has made a careful examination of the contract documents; that she/he has fully informed herself/himself as to the quality and quantity of materials and the character of the work required; and that she/he has made a careful examination of the locations and conditions of the work and



the source of supply for materials. The Owner will in no case be responsible for any loss or for any unanticipated costs that may be suffered by the Contractor as a result of the Contractor's failure to fully inform herself/himself in advance in regard of all conditions pertaining to the work.

7. Award and Basis of Award of Contract

Within ten (10) days after the opening of the bids, the Owner will accept one of the bids or reject all of the bids received. The City of Cottage Grove will provide notice of its intent to award in writing per OAR 137-049-0395.

It is the Owner's intent to award a single contract to the responsible bidder who submits the lowest total bid and whose proposal complies with these and all other contract documents.

In determination of the lowest responsible bidder, the City of Cottage Grove reserves the right to take into account and give reasonable weight to the extent of the bidder's experience on work of the nature involved, on the bidder's record as to dependability in the carrying out of other contracts, and evidence of present ability to perform the contract in a satisfactory manner.

The Owner also reserves the right to reject any or all bids, and to waive any informality or technicality in the bids received or in the bidding procedure.

8. Execution of Contract and Damages for Failure to Execute

The bidder whose proposal is accepted will be required within ten (10) calendar days after notice that a contract has been awarded to him/her, to appear and execute a contract with the City of Cottage Grove for the full and complete performance of all work and payment for all labor and materials specified therein, and execute bonds for the faithful performance and payment of such contract in the sum of the total amount of the contract satisfactory to the Owner. Said bonds shall be with a surety company as bondsman whose financial standing and record of service is satisfactory to the Owner. Said performance, payment, and public works bonds shall be in force for one year after acceptance of the completed work to cover all guarantees against defective workmanship and materials.

At the time of executing the contract, the successful bidder shall also submit to the Owner the required Certificate of Insurance. Should the successful bidder fail or refuse to execute the contract and furnish the bonds and insurance certification, then the bid security deposited by said bidder shall be retained as liquidated damages by the Owner.

9. Beginning of the Work

It is the intent of the Owner that this work begin without delay. The Contractor shall commence the work contemplated under these contract documents within ten (10) calendar days of receipt of Owner's "Notice to Proceed", unless otherwise directed by the Engineer, and shall complete the same within the time specified in the proposal, it being expressly understood and agreed that the time of beginning, the rate of progress and time of completion of the work are of the essence of this contract.

10. Submission of Pre-qualification Forms

Bidders must be pre-qualified with the City of Cottage Grove or the Oregon Department of Transportation in accordance with ORS 279C.430. A completed City of Cottage Grove Pre-qualification form or Oregon Department of transportation Pre-qualification form must be submitted to the City of Cottage Grove by all perspective bidders on or before 5:00 p.m., Friday, March 17, 2023. Bidders must be pre-qualified in water treatment facility construction.

11. Submission of Bids

Each bid shall be sealed in an envelope, properly addressed to the Ron Bradsby, City Engineer, City of Cottage Grove, 400 East Main Street, Cottage Grove, Oregon, and showing on the outside of the envelope the name of the bidder, the project, the date and hour of opening, and the words "sealed bid" per OAR 137-049-0200(1)(a)(D). Bids will be received at the time and place stated in the Advertisement for Bids.

12. Funding and Owner

This project is being funded by state and local funds.

13. Minimum Wage

The minimum rate to be paid all crafts and labor on this contract shall be the prevailing wage rate for the individual crafts involved in the Lane County area during the life of the contract or the minimum wage specified in a wage determination decision of the State of Oregon, Commissioners of the Bureau of Labor, whichever is higher.

14. Indemnity

Each bidder agrees that his/her performance under this contract is at his/her sole risk and that she/he shall indemnify the City of Cottage Grove and, officers, agents and employees, against and hold them harmless from, any and all liability for damages, costs, losses and expenses resulting from, arising out of or in any way connected with this contract, or from Contractor's failure to perform fully hereunder, and bidder further agrees to defend the City of Cottage Grove, their officers, agents and employees against all such suits, actions or proceedings brought by any third party against them for which the Contractor would be liable there under.

15. Withdrawal of Bids

Any bidder may withdraw their bid, either personally or by written request, in accordance with OAR 137-049-0320(2)(a), at any time prior to closing. However, upon opening, all bids shall be irrevocable for a period of SIXTY (60) days from the time of opening.

16. Items to be Returned with Submission of Bid

- a. Bid Schedule.
- b. Resident Bidder Status Certification form.
- c. Bid security, not less than ten (10) percent of the total bid.
- d. All addenda or acknowledgment therefore, if any.

Note: A completed City of Cottage Grove Pre-qualification form or Oregon Department of Transportation Pre-qualification form must be submitted no later than 5:00 p.m., Friday, March 17, 2023.

17. Addenda

The City of Cottage Grove will not mail notice of Addenda, but will publish notice of any Addenda on the City's website. Prospective bidders should frequently check the City's website until closing (i.e., at least once weekly until the week of closing and at least once daily the week of or before closing). In all other ways, addenda shall be issued as set forth in OAR 137-049-0250.

18. Solicitation and Award Protests

Solicitation protests will be handled pursuant to OAR 137-049-0260(3) and award protests will be handled pursuant to OAR 137-049-0450(4).

19. Items to be Returned Within 2 hours of Bid Opening

In accordance with ORS 279C.370, all bidders must submit to the City of Cottage Grove on the attached form (next page) within two (2) hours following the date and time of bid opening, a list of all first tier Subcontractors, who will furnish labor or labor and materials on the project and whose subcontract amounts are at least 5% of the Contractor's total bid amount, but at least \$15,000, or \$350,000, regardless of the percentage of the total project bid.

In accordance with ORS 279C.370 all bidders must submit to the Owner on the attached form (next page) within 2 hours following the date and time of bid opening, a list of all first tier Subcontractors who will perform work on the project and whose subcontract amounts are at least 5% of the Contractors total bid amount or \$15,000, whichever is larger; or \$350,000, regardless of the percentage of the total project bid.

20. Asbestos Abatement Projects

A Contractor or Subcontractor under this contract will not be required to be licensed under ORS 468A.720 regarding asbestos abatement projects.  
OAR 137-049-0200(1)(a)(L)

21. Pre-bid Conference

A **mandatory** pre-bid conference will be held in the office of the City Engineer in City Hall, 400 East Main Street, Cottage Grove, Oregon at 1:00 p.m. on Thursday, March 16, 2023, to discuss the technical features of the proposed work. A tour of the job site will follow.

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## FIRST-TIER SUBCONTRACTOR DISCLOSURE FORM

PROJECT NAME: SECODNARARY CLARIFIER 1 REHABILITATION

JOB #: 20172

BID CLOSING: Date: April 5, 2023 Time: 10:00 a.m.

This form must be submitted at the location specified in the invitation to Bid on the advertised bid closing date and within two working hours after the advertised bid closing time.

List below the name of each Subcontractor that is required to be disclosed, the category of work that the Subcontractor will be performing and the dollar value of the subcontract. Enter "NONE" if there are no Subcontractors that need to be disclosed. (ATTACH ADDITIONAL SHEETS IF NEEDED.)

Name and CCB Number	Dollar Value	Category of Work
	\$	
	\$	
	\$	
	\$	
	\$	
	\$	
	\$	
	\$	

Failure to submit this form by the disclosure deadline will result in a non-responsive bid. A non-responsive bid will not be considered for award.

Form submitted by (bidder name): \_\_\_\_\_

Contact name: \_\_\_\_\_

Phone number: \_\_\_\_\_

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## PROJECT BID

PROJECT: SECODNARARY CLARIFIER 1 REHABILITATION

TO: City of Cottage Grove  
400 East Main Street  
Cottage Grove, OR 97424

1. The undersigned bidder agrees and certifies as follows:
  - a. Bidder shall be bound by and will comply with the provisions of ORS 279C.840 and 40 U.S.C. 276a;
  - b. Bidder is/is not a resident bidder, as defined in ORS 279A.120 (circle one);
  - c. Bidder will comply with the provisions of ORS 305.385 relating to Oregon tax laws;
  - d. Bidder has not and will not discriminate against minority, women, or emerging small businesses, business enterprises, or a business enterprise that is controlled by or that employs a disabled veteran, as defined in ORS 408.225 in obtaining any required subcontracts. Bidder acknowledges that failure to do so shall be grounds for disqualification;
  - e. Bidder, its subcontractors, if any, and all employers working on this project are subject employers under the Oregon Workers' Compensation law and shall comply with ORS 656.017, which requires them to provide worker's compensation coverage for all their subject workers;
  - f. Bidder is registered and in good standing with the Construction Contractors Board, in accordance with ORS 701.035 to 701.055;
  - g. All sub-Contractors performing work as described in ORS 701.005(2) will be registered with the Construction Contractors Board in accordance with ORS 701.035 to 701.055 before the sub-Contractors commence work under the contract.
2. The undersigned bidder, having familiarized her/himself with the drawings, specifications, and other contract documents related to the City of Cottage Grove's SECODNARARY CLARIFIER 1 REHABILITATION project, hereby proposes to furnish all materials, equipment, and labor necessary to perform all work to complete the CLARIFIER PHASE 1 project in strict accordance with the plans, specifications and this proposal, all of which are made a part of the contract documents herein by this reference.
3. This bid includes all fees, taxes, profit, overhead, tools, expendable equipment, utilities, transportation costs and other expenses necessary to complete this project.
4. It is understood that the sum of the bid item amounts shall constitute complete compensation for the SECODNARARY CLARIFIER 1 REHABILITATION project and all appurtenances complete and ready for operation as shown in the plans and specifications.

The City reserves the right to delete any bid item from a Bid Schedule and/or delete an entire Bid Schedule(s) and the undersigned bidder will make no claims for anticipated profits or additional compensation for any such decrease in the work.

5. The bidder declares that he/she has visited the site of the proposed work and has become fully acquainted with conditions relating to construction and labor and understands fully the facilities, difficulties and restrictions attending the execution of the work under the contract.
6. The bidder agrees, if awarded the contract, to execute and deliver to the City of Cottage Grove, within ten (10) calendar days after formal award, signed copies of the contract, in triplicate: satisfactory performance, payment and public works bonds; and appropriate certificate of insurance.
7. The bidder further agrees that the required bid security consisting of a certified check or bid bond, in the amount of ten (10) percent of the bid is hereto attached, and that the bid security will be placed in escrow with the City of Cottage Grove; that should the undersigned fail to execute an agreement, the performance bond, the public works bond, the payment bond, and certificate of insurance within ten (10) calendar days after his/her proposal has been accepted, the bid security shall be forfeited as liquidated damages; but if this bid is not accepted within ten (10) days of the time set for the opening of the bids, or if the undersigned executes and timely delivers said agreement and documents, the bid security shall be returned.
8. It is understood that the undersigned bidder may withdraw his bid at any time prior to the date and time of bid opening, but that all bids shall be irrevocable for a period of sixty (60) days from the time of opening.
9. The bidder proposes to commence the work on or before a date to be specified in the "Notice to Proceed" and to complete the work in all respects within two hundred and fifty-five (255) calendar days thereafter; whichever comes first, in accordance with the plans, specifications, and contract documents for:

#### SECONDARY CLARIFIER 1 REHABILITATION

10. In the event the bidder is awarded a contract and shall fail to complete the work within the time limit specified, or the extended time limit as provided in the specifications, liquidated damages shall be paid by the Contractor to the City of Cottage Grove, at the rate per day specified in the General Conditions until the work is complete in all respects.
11. Receipt of the following addenda to the plans and/or specifications is hereby acknowledged:

Addendum No.	Date of Receipt of Addendum	Signed Acknowledgment

(NOTE: Failure to acknowledge receipt of Addenda may be considered an irregularity in the Proposal.)

12. The undersigned as bidder declares that the only person or parties interested in this proposal, as principals, are those named herein; that his/her proposal is made without collusion with any other person, firm or corporation; that she/he has carefully examined the contract documents, including the specifications and special provisions and project site, and that she/he will contract with Owner to furnish the services and materials as specified, in the manner and



the time therein prescribed and according to all the requirements set forth therein, and that the contents of this bid have not been communicated by the bidder, his/her employees or agents to any person not an employee or agent of the bidder.

NAME OF BIDDER: \_\_\_\_\_

ADDRESS: \_\_\_\_\_

SIGNATURE: \_\_\_\_\_

TITLE: \_\_\_\_\_

IF CORPORATION (ATTEST): \_\_\_\_\_

Dated this \_\_\_\_\_ day of \_\_\_\_\_, 2021

Notary

My Commission Expires: \_\_\_\_\_

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## BID SCHEDULE

### Base Bid Schedule

The Bid amount for each of the Bid Items below must be filled in and completed.

Bid prices shall include everything necessary for the completion of the work stipulated in the Contract Documents, including but not limited to providing materials, equipment, tools, management, superintendence, labor and services. Bid prices shall include all federal, state, and local taxes.

In the event that the addition of the bid item extended amounts does not equal the Total Base Bid Prices, the corrected addition of all the bid item extended amounts will govern and the Owner will correct the Total Base Bid Price accordingly.

If the Bid Schedule contains neither the item nor the total price for an item, then it shall be deemed incomplete and the Bid shall be deemed non-responsive by the Owner.

Item	Description (with price in words)	Unit	Estimated Quantity	Unit Price	Total Bid Price (in figures)
1	Mobilization and Demobilization	LS	1		
2	Perform all General Conditions	LS	1		
3	Demo handrailing around Secondary Clarifier	LF	286		
4	Install handrail around Secondary Clarifier	LF	286		
5	Demo portion of sidewalk	CY	2		
6	Demo center column foundation	CY	23		
7	Concrete work (foundation, new stairs, sidewalk, and concrete footing)	CY	31		
8	Wall and trough repairs (sandblast)	SF	3752		
9	Pressure injection for wall repairs	LF	140		
10	Remove 2" grout from existing slab	SF	3526		
11	Add 2" fiberglass reinforced grout & bonding adhesive to existing slab	SF	3526		
12	Repair existing wall, weir, and trough with cementitious coating	SF	4780		
13	Remove and replace existing floor relief valves, includes demo of 4-foot opening in floor	EA	4		

Item	Description (with price in words)	Unit	Estimated Quantity	Unit Price	Total Bid Price (in figures)
14	Install new relief valves, includes demo of 4-foot opening in floor	EA	4		
15	Sawcut & remove floor for 12" RAS pipe removal	SF	7		
16	Installation of new 12" RAS pipe	LF	10		
17	Sawcut & remove floor for 24" RCP ML pipe removal	LF	12.5		
18	Installation of new 24" RCP ML pipe removal	LF	10		
19	Demo Secondary Clarifier Mechanism, including but not limited to sludge and scum collection equipment, scum troughs, scum baffles, weir plates, drive equipment, bridge, and walkway for access to the drive equipment, and miscellaneous appurtenances	LS	1		
20	Assemble and install Secondary Clarifier Mechanism (Includes sludge and scum collection equipment, scum troughs, scum baffles, weir plates, drive equipment, bridge, and walkway for access to the drive equipment, and miscellaneous appurtenances)	LS	1		
21	Trough joint repairs	EA	5		
22	Demo 1" HCS pipe around scum baffle	LF	268		
23	Replace 1" HCS pipe, diaphragm valve, & pipe supports around scum baffle	LF	268		
24	Removal and Reattachment of Stamford Baffle	LS	1		
25	Demo existing 1" 3W piping, valves, and insulation	LS	1		
26	Replace 1" 3W piping, valves, and insulation	LS	1		
27	Demo existing 3/4" alum piping, valves, and insulation	LS	1		

Item	Description (with price in words)	Unit	Estimated Quantity	Unit Price	Total Bid Price (in figures)
28	Replace 3/4" alum piping, valves, and insulation	LS	1		
29	Start-up, Testing, Training, and Commissioning	LS	1		

TOTAL BASE BID PRICE (Items 1 through 29)      \$\_\_\_\_\_

(in words) \_\_\_\_\_

\_\_\_\_\_dollars

#### **Additive Bid Alternates**

No additive bids are included as part of this bid.

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## RESIDENT/NONRESIDENT BIDDER STATUS

Oregon law requires that the City of Cottage Grove, in determining the lowest responsive bidder, must add a percent increase on the bid of a nonresident bidder equal to the percent, if any, of the preference given to that bidder in the state in which that bidder resides.

Consequently, each bidder must indicate whether it is a resident or nonresident bidder. A resident bidder is a bidder that has paid unemployment taxes or income taxes in Oregon during the 12 calendar months immediately preceding submission of this bid, has a business address in Oregon, and has stated in its bid whether the bidder is a "resident bidder". A "nonresident bidder" is a bidder who is not a resident bidder.

The undersigned bidder states that it is: (check one)

1. A resident bidder \_\_\_\_\_
2. A nonresident bidder \_\_\_\_\_

Indicate state in which bidder resides: \_\_\_\_\_

## CONSTRUCTION CONTRACTORS REGISTRATION

Oregon law requires that all Contractors must be registered with the Construction Contractors Board in order to submit a bid to do work and to do work as a Contractor. The undersigned bidder states that it is now registered with the Oregon Contractors Board.

Indicate the bidder's registration no. \_\_\_\_\_

\_\_\_\_\_  
Signature of Bidder & Company

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**CONTRACT FOR CONSTRUCTION**  
**OF**  
**SECONDNARARY CLARIFIER 1 REHABILITATION**

THIS CONTRACT, made and entered into this \_\_\_\_ day of \_\_\_\_\_, 2023  
by and between the City of Cottage Grove hereinafter called the OWNER and \_\_\_\_\_  
\_\_\_\_\_ hereinafter called the CONTRACTOR.

WITNESSETH:

Said CONTRACTOR, in consideration of the sum to be paid by the said OWNER  
and of the covenants and agreements herein contained, hereby agrees to commence and  
complete the construction described as follows:

**SECONDNARARY CLARIFIER 1 REHABILITATION**

hereinafter called the PROJECT and to the extent of the Proposal made by the CONTRACTOR  
on the \_\_\_\_ day of \_\_\_\_\_, 2023, all in full compliance with the Contract  
Documents referred to herein.

The "Advertisement for Bids", the "Instructions to Bidders", the signed copy of the "Bidder's  
Proposal", the signed copy of the "Addenda", the "General Conditions, the "Special Provisions",  
the "Technical Specifications", the "Performance Bond", the "Payment Bond", the "Public Works  
Bond", and the "Insurance Certification", the "Notice of Award", "Prevailing Wage Rates, dated  
July 1, 2022" published by the State of Oregon Bureau of Labor and Industry (BOLI) , the most  
recent "Oregon Standard Specifications for Construction" including modifications and revisions,  
and the "Plans", which include all maps, plats and prints are hereby referred to and by this  
reference are made a part of this Contract as fully and completely as if same were fully set forth  
herein and are mutually cooperative herewith.

In consideration of the faithful performance of the work herein embraced, as set forth in  
these Contract Documents, and in accordance with the direction of the Engineer and to his  
satisfaction to the extent provided in the Contract Documents, the OWNER agrees to pay the  
CONTRACTOR the amount bid as adjusted in accordance with and as determined by the  
provisions of these Contract Documents, and based on the said Bid made by the  
CONTRACTOR, and to make such payments in the manner and at the times provided in these  
Contract Documents.

The CONTRACTOR agrees to indemnify and save harmless the OWNER from any and  
all defects appearing or developing in the workmanship performed or furnished under this  
Contract while in progress and for a period of one (1) year after the final acceptance thereof by  
the OWNER.

It is agreed that the time limit for the completion of the contract, based on the Bidder's  
Proposal shall be one hundred ninety-four (194) calendar days. In the event the  
CONTRACTOR shall fail to complete the work within the time limit, or extended time limit  
agreed upon as more particularly set forth in these Contract Documents, liquidated damages

shall be computed at the rate indicated in the SCHEDULE OF LIQUIDATED DAMAGES, Item 5.3 of the General Conditions.

The parties further agree that this amount of liquidated damages is a reasonable forecast of just compensation for the harm caused by any breach and that this harm is one which is impossible or very difficult to accurately estimate.

Contractor shall comply with all applicable provisions of federal, state, and local laws, including without limitation, applicable provisions of the Oregon Public Contracting Code ORS 279C, as more specifically set forth on Exhibit A. (See attached "Exhibit A")

Contractor shall not assign, sell, dispose of, or transfer rights, nor delegate duties under the Contract, wither in whole or in part, without the City of Cottage Grove's prior written consent. Such consent shall not relieve Contractor of any obligations under the Contract. Any assignee or transferee shall be considered the agent of the Contractor and bound to abide by all provisions of the Contract. If the City of Cottage Grove consents in writing to an assignment, sale, disposal, or transfer of the Contractor's rights or delegation of Contractor's duties, the Contractor and its surety shall remain liable to the City of Cottage Grove for complete performance of the Contract as if no such assignment, sale, disposal, transfer, or delegation had occurred, unless the City of Cottage Grove otherwise agrees in writing.

IN WITNESS WHEREOF, we the parties hereto each subscribe to the same this \_\_\_\_\_ day of \_\_\_\_\_, 2023.

OWNER

BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

ATTEST: \_\_\_\_\_  
CITY RECORDER

CONTRACTOR

BY: \_\_\_\_\_

TITLE: \_\_\_\_\_

IF THE CONTRACTOR IS A  
CORPORATION:

ATTEST: \_\_\_\_\_

TITLE: \_\_\_\_\_

(SEAL)

## **EXHIBIT A**

### **Public Contracting Code**

#### **Requirements for Public Improvement Contracts Over \$50,000**

1. Contractor shall pay promptly, as due, all persons supplying labor or materials for the prosecution of the work provided for in the contract, and shall be responsible for such payment of all persons supplying such labor or material to any Subcontractor.
  - (a) ORS 279C.580(3)(a) requires the prime Contractor to include a clause in each subcontract requiring Contractor to pay the first-tier Subcontractor for satisfactory performance under its subcontract within 10 days out of such amounts as are paid to the prime Contractor by the public contracting agency; and
  - (b) ORS 279C.580(3)(b) requires the prime Contractor to include a clause in each subcontract requiring Contractor to pay an interest penalty to the first-tier Subcontractor if payment is not made within 30 days after receipt of payment from the public contracting agency.
  - (c) ORS 279C.580(4) requires the prime Contractor to include in every subcontract a requirement that the payment and interest penalty clauses required by ORS 279C.580(3)(a) and (b) be included in every contract between a Subcontractor and a lower-tier Subcontractor or supplier.
2. Contractor shall promptly pay all contributions or amounts due the Industrial Accident Fund from such Contractor or Subcontractor incurred in the performance of the contract, and shall be responsible that all sums due the State Unemployment Compensation Fund from Contractor or any Subcontractor in connection with the performance of the contract shall promptly be paid.
3. Contractor shall not permit any lien or claim to be filed or prosecuted against the Contracting Agency on account of any labor or material furnished and agrees to assume responsibility for satisfaction of any such lien so filed or prosecuted.
4. A notice of claim on Contractor's payment bond shall be submitted only in accordance with ORS 279C.600 and 279C.605.
5. Contractor and any Subcontractor shall pay to the Department of Revenue all sums withheld from employees pursuant to ORS 316.167.
6. Contractor shall demonstrate to the Contracting Agency that an employee drug-testing program is in place within 10 days of receiving a Notice of Award.
7. Pursuant to ORS 279C.515, if Contractor fails, neglects or refuses to make prompt payment of any claim for labor or materials furnished to the Contractor or a Subcontractor by any person in connection with the contract as such claim becomes due, the Contracting Agency may pay such claim to the persons furnishing the labor or material and charge the amount of payment against funds due or to become due Contractor by reason of the contract. The payment of a claim in the manner authorized hereby shall not relieve the Contractor or his surety from his or its obligation with respect to any unpaid claim. If the Contracting Agency is unable to determine the validity of any claim for labor or material furnished, the Contracting Agency may withhold from any current payment due Contractor an amount equal to said claim until its validity is determined and the claim, if valid, is paid.

8. Pursuant to ORS 279C.515, if the Contractor or a first-tier Subcontractor fails, neglects, or refuses to make payment to a person furnishing labor or materials in connection with the public contract for a public improvement within 30 days after receipt of payment from the Contracting Agency or Contractor, the Contractor or first-tier Subcontractor shall owe the person the amount due plus interest charges commencing at the end of the 10 day period that payment is due under ORS 279C.580(4) and ending upon final payment, unless payment is subject to a good faith dispute as defined in ORS 279C.580. The rate of interest charged to Contractor or first-tier Subcontractor on the amount due shall equal three times the discount rate on 90-day commercial paper in effect at the Federal Reserve Bank in the Federal Reserve District that includes Oregon on the date that is 30 days after the date when payment was received from the public contracting agency or from the Contractor, but the rate of interest shall not exceed 30%. The amount of interest may not be waived.
9. As provided in ORS 279C.515, if the Contractor or a Subcontractor fails, neglects, or refuses to make payment to a person furnishing labor or materials in connection with the public contract, the person may file a complaint with the Construction Contractor's Board, unless payment is subject to a good faith dispute as defined in ORS 279C.580.
10. Pursuant to ORS 279C.530, Contractor shall promptly, as due, make payment to any person, co-partnership, association, or corporation, furnishing medical, surgical and hospital care or other needed care and attention, incident to sickness or injury, to employees of such Contractor, of all sums which the Contractor agrees to pay for such services and all monies and sums which the Contractor collected or deducted from the wages of employees pursuant to any law, contract or agreement for the purpose of providing or paying for such service.
11. Contractor shall employ no person for more than 10 hours in any one day, or 40 hours in any one week, except in cases of necessity, emergency, or where public policy absolutely requires it, and in such cases, except in cases of contracts for personal services designated under ORS 279A.055, Contractor shall pay the employee at least time and one-half pay for all overtime in excess of eight (8) hours a day or forty (40) hours in any one week when the work is five (5) consecutive days, Monday through Friday; or for all overtime in excess of 10 hours a day or 40 hours in any one week when the work week is 4 consecutive days, Monday through Friday; and for all work performed on Saturday and on any legal holidays as specified in ORS 279C.540.
12. Pursuant to ORS 279C.540(2), the Contractor must give notice to employees who work on this contract in writing, either at the time of hire or before commencement of work on the contract, or by posting a notice in a location frequented by employees, of the number of hours per day and the days per week that the employees may be required to work.
13. The provisions of ORS 279C.800 to ORS 279C.870 relating to the prevailing wage rates will be complied with. The hourly rate of wage to be paid by Contractor or any Subcontractor to workers in each trade or occupation required for the public works employed in the performance of this Contract shall not be less than the specified minimum rate of wage in accordance with ORS 279C.838 and ORS 279C.840.
  - (a) The latest prevailing wage rates for public works contracts in Oregon are contained in the following publications: The July 1, 2022 Prevailing Wage Rates for Public Works Projects in Oregon. Such publications can be reviewed electronically at:

and are hereby incorporated as part of the contract documents.

- (b) Contractor and all Subcontractors shall keep the prevailing wage rates for this Project posted in a conspicuous and accessible place in or about the Project.
  - (c) The Owner shall pay a fee to the Commissioner of the Oregon Bureau of Labor and Industries as provided in ORS 279C.825. The fee shall be paid to the Commissioner as required by the administrative rules adopted by the Commissioner.
  - (d) If Contractor or any Subcontractor also provides for or contributes to a health and welfare plan or a pension plan, or both, for its employees on the Project, it shall post notice describing such plans in a conspicuous and accessible place in or about the Project. The notice shall contain information on how and where to make claims and where to obtain future information.
14. Unless exempt under ORS 279C.836(4), (7), (8) or (9), before starting work on this contract, or any subcontract hereunder, Contractor and all Subcontractors must have on file with the Construction Contractors Board a public works bond with a corporate surety authorized to do business in the state of Oregon in the amount of \$30,000. The bond must provide that the Contractor or Subcontractor will pay claims ordered by the Bureau of Labor and Industries to workers performing labor upon public works projects. The bond must be a continuing obligation, and the surety's liability for the aggregate of claims that may be payable from the bond may not exceed the penal sum of the bond. The bond must remain in effect continuously until depleted by claims paid under ORS 279C.836(2), unless the surety sooner cancels the bond. The surety may cancel the bond by giving 30 days' written notice to the Contractor or Subcontractor, to the board and to the Bureau of Labor and Industries. When the bond is canceled, the surety is relieved of further liability for work performed on contracts entered into after the cancellation. The cancellation does not limit the surety's liability for work performed on contracts entered into before the cancellation. Contractor further certifies that Contractor will include in every subcontract or provision requiring a Subcontractor to have a public works bond filed with the Construction Contractors Board before starting work on the project, unless exempt under ORS 279C.836(4), (7), (8), or (9).
- (a) Unless exempt under ORS 279C.836(4), (7), (8), or (9), before permitting a Subcontractor to start work on this public works project, the Contractor shall verify that the Subcontractor has filed a public works bond as required under this section or has elected not to file a public works bond under ORS 279C.836(7).
  - (b) Unless public contracting agency has been notified of any applicable exemptions under ORS 279C.836(4), (7), (8), or (9), the public works bond requirement above is in addition to any other bond Contractors or Subcontractors may be required to obtain under this contract.
15. As may be required by ORS 279C.845, Contractor or Contractor's surety and every Subcontractor or Subcontractor's surety shall file certified payroll statements with the Contracting Agency in writing.
- (a) If a Contractor is required to file certified statements under ORS 279C.845, the Contracting Agency shall retain 25% of any amount earned by the Contractor on the public works project until the Contractor has filed with the Contracting Agency

statement as required by ORS 279C.845. The Contracting Agency shall pay the Contractor the amount retained within 14 days after the Contractor files the required certified statements, regardless of whether a Subcontractor has failed to file certified statements required by statute. The Contracting Agency is not required to verify the truth of the contents of certified statements filed by the Contractor under this section and ORS 279C.845.

- (b) The Contractor shall retain 25% of any amount earned by a first-tier Subcontractor on this public works contract until the Subcontractor has filed with the Contracting Agency certified statements as required by ORS 279C.845. The Contractor shall verify that the first-tier Subcontractor has filed the certified statements before the Contractor may pay the Subcontractor any amount retained. The Contractor shall pay the first-tier Subcontractor the amount retained within 14 days after the Subcontractor files the certified statements as required by ORS 279C.845. Neither the Contracting Agency nor the Contractor is required to verify the truth of the contents of certified statements filed by a first-tier Subcontractor.
- 16. All employers, including Contractor, that employ subject workers who work under this contract shall comply with ORS 656.017 and provide the required Workers' Compensation coverage, unless such employers are exempt under ORS 656.126. Contractor shall ensure that each of its Subcontractors complies with these requirements.
- 17. All sums due the State Unemployment Compensation Fund from the Contractor or any Subcontractor in connection with the performance of the contract shall be promptly so paid.
- 18. The contract may be canceled at the election of Contracting Agency for any willful failure on the part of Contractor to faithfully perform the contract according to its terms.
- 19. Contractor certifies that it has not discriminated against minorities, women or emerging small business enterprises or a business enterprise that is owned or controlled by or that employs a disabled veteran as defined in ORS 408.225 in obtaining any required Subcontractors. ORS 279A.110.
- 20. Contractor certifies its compliance with the Oregon tax laws, in accordance with ORS 305.385.
- 21. In the performance of this contract, the Contractor shall use, to the maximum extent economically feasible, recycled paper, materials, and supplies, and shall compost or mulch yard waste material at an approved site, if feasible and cost effective.
- 22. As may be applicable, Contractor certifies that all Subcontractors performing construction work under this contract will be registered with the Construction Contractors Board or licensed by the state Landscaping Contractors Board in accordance with ORS 701.035 to ORS 701.055 before the Subcontractors commence work under this contract.
- 23. Pursuant to Contracting Agency Public Contracting Rule 137-049-0880, the Contracting Agency may, at reasonable times and places, have access to and an opportunity to inspect, examine, copy, and audit the records relating to the Contract.
- 24. In compliance with the provisions of ORS 279C.525, the following is a list of federal, state and local agencies, of which the Contracting Agency has knowledge, that have enacted

ordinances or regulations dealing with the prevention of environmental pollution and the preservation of natural resources that may affect the performance of the contract:

#### FEDERAL AGENCIES:

- Agriculture, Department of
  - Forest Service
  - Soil Conservation Service
- Defense, Department of
  - Army Corps of Engineers
- Environmental Protection Agency
- Interior, Department of
  - Bureau of Sport Fisheries and Wildlife
  - Bureau of Outdoor Recreation
  - Bureau of Land Management
  - Bureau of Indian Affairs
  - Bureau of Reclamation
- Labor, Department of
  - Occupational Safety and Health Administration
- Transportation, Department of
  - Federal Highway Administration
- Homeland Security, Department of
  - Coast Guard

#### STATE AGENCIES:

- Agriculture, Department of
- Environmental Quality, Department of
- Fish and Wildlife, Department of
- Forestry, Department of
- Geology and Mineral Industries, Department of
- Human Resources, Department of
- Land Conservation and Development Commission
- Soil and Water Conservation Commission
- State Engineer
- State Land Board
- Water Resources Board

#### LOCAL AGENCIES:

- City Council
- County Court
- County Commissioners, Board of
- Port Districts
- Metropolitan Service Districts
- County Service Districts
- Sanitary Districts
- Water Districts
- Fire Protection Districts

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## PERFORMANCE BOND

(Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable)

Contractor (Name and Address):

Surety (Name and Principal Place of Business):

Owner (Name and Address): City of Cottage Grove  
400 East Main Street  
Cottage Grove, OR 97424

Construction Contract:

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

Amount: \_\_\_\_\_

Description (Name and Location): \_\_\_\_\_

Bond:

Date (Not earlier than Construction Contract Date): \_\_\_\_\_

Amount: \_\_\_\_\_

Modifications to this Bond: None, See Page 4

CONTRACTOR AS PRINCIPAL  
Company: \_\_\_\_\_  
(Corporate Seal)

SURETY  
Company: \_\_\_\_\_  
(Corporate Seal)

Signature: \_\_\_\_\_

Signature: \_\_\_\_\_

Name and Title: \_\_\_\_\_

Name and Title: \_\_\_\_\_

(Any additional signatures appear on page 4)

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(FOR INFORMATION ONLY - Name, Address and Telephone)

AGENT OR BROKER:

OWNER'S REPRESENTATIVE:  
(Architect, Engineer or other Party):

- 1 The Contractor and the Surety, jointly and severally bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for the performance of the Construction Contract, which is incorporated herein by reference.
- 2 If the Contractor performs the Construction Contract, the Surety and the Contractor shall have no obligation under this Bond, except to participate in conferences as provided in Subparagraph 3.1.
- 3 If there is not Owner Default, the Surety's obligation under this Bond shall arise after:
  - 3.1 The Owner has notified the Contractor and the Surety at its address described in Paragraph 10 below that the Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with the Contractor and the Surety to be held not later than fifteen days after receipt of such notice to discuss methods of performing the Construction Contract. If the Owner, the Contractor and the Surety agree, the Contractor shall be allowed to reasonably time to perform the Construction Contract, but such an agreement shall not waive the Owner's right, if any, subsequently to declare a Contractor Default; and
  - 3.2 The Owner has declared a Contractor Default and formally terminated the Contractor's right to complete the contract. Such Contractor Default shall not be declared earlier than twenty days after the Contractor and the Surety have received notice as provided in Subparagraph 3.1; and
  - 3.3 The Owner has agreed to pay the Balance of the Contract Price to the Surety in accordance with the terms of the Construction Contract or to a Contractor selected to perform the Construction Contract in accordance with the terms of the contract with the Owner.
- 4 When the Owner has satisfied the conditions of Paragraph 3, the Surety shall promptly and at the Surety's expense take one of the following actions:
  - 4.1 Arrange for the Contractor, with consent of the Owner, to perform and complete the Construction Contract; or
  - 4.2 Undertake to perform and complete the Construction Contract itself, through its agents or through independent Contractors; or
  - 4.3 Obtain bids or negotiated proposals from qualified Contractors acceptable to the Owner for a contract for performance and completion of the Construction Contract, arrange for a contract to be prepared for execution by the Owner and the Contractor selected with the Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Construction Contract, and pay to the Owner the amount of damages as described in Paragraph 6 in excess of the Balance of the Contract Price incurred by the Owner resulting from the Contractor's default; or
  - 4.4 Waive its right to perform and complete, arrange for completion, or obtain a new Contractor and with reasonable promptness under the circumstances;
    - .1 After investigation, determine the amount for which it may be liable to the Owner and, as soon as practicable after the amount is determined, tender payment therefore to the Owner; or
    - .2 Deny liability in whole or in part and notify the Owner citing reasons therefore.

- 5 If the Surety does not proceed as provided in Paragraph 4 with reasonable promptness, the Surety shall be deemed to be in default on this Bond fifteen days after receipt of an additional written notice from the Owner to the Surety demanding that the Surety perform its obligations under this Bond, and the Owner shall be entitled to enforce any remedy available to the Owner. If the Surety proceeds as provided in Subparagraph 4.4, and the Owner refuses the payment tendered or the Surety has denied liability, in whole or in part, without further notice the Owner shall be entitled to enforce any remedy available to the Owner.
- 6 After the Owner has terminated the Contractor's right to complete the Construction Contract, and if the Surety elects to act under Subparagraph 1.1, 4.2, or 4.3 above, then the responsibilities of the Surety to the Owner shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall not be greater than those of the Owner under the Construction Contract. To the limit of the amount of this Bond, but subject to commitment y the Owner of the Balance of the Contract Price to mitigation of costs and damages on the Construction Contract, the Surety is obligated without duplication for:
  - 6.1 The responsibilities of the Contractor for correction of defective work and completion of the Construction Contract;
  - 6.2 Additional legal, design professional and delay costs resulting from the Contractor's Default, and resulting from the actions or failure to act of the Surety under Paragraph 4; and
  - 6.3 Liquidated damages, or if no liquidated damages are specified in the Construction Contract, actual damages caused by delayed performance or non-performance of the Contractor.
- 7 The Surety shall not be liable to the Owner or others for obligations of the Contractor that are unrelated to the Construction Contract, and the Balance of the Contract Price shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than the Owner of its heirs, executors, administrators or successors.
- 8 The Surety hereby waives notice of any change, including changes of time, to the Construction Contract or to related subcontracts, purchase orders and other obligations.
- 9 Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after Contractor Default or within two years after the Contractor ceased working or within two years after the Surety refuses or fails to perform its obligations under this Bond, whichever occurs first. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suite shall be applicable.
- 10 Notice to the Surety, the Owner or the Contractor shall be mailed or delivered to the address shown on the signature page.
- 11 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed

incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.

## 12 DEFINITIONS

- 12.1 Balance of the Contract Price: The total amount payable by the Owner to the Contractor under the Construction Contract after all proper adjustments have been made, including allowance to the Contractor of any amounts received or to be received by the Owner in settlement of insurance or other claims for damages to which the Contractor is entitled, reduced by all valid and proper payments made to or on behalf of the Contractor under the Construction Contract.
- 12.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract documents and changes thereto.
- 12.3 Contractor Default: Failure of the Contractor, which has neither been remedied nor waived, to perform or other wise to comply with the terms of the Construction Contract.
- 12.4 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

MODIFICATIONS TO THIS BOND ARE AS FOLLOWS:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL  
Company:

SURETY  
Company:

Signature: \_\_\_\_\_

Signature: \_\_\_\_\_

Name and Title: \_\_\_\_\_

Name and Title: \_\_\_\_\_

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

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

## PAYMENT BOND

(Any singular reference to Contractor, Surety, Owner or other party shall be considered plural where applicable)

Contractor (Name and Address):

Surety (Name and Principal Place of Business):

Owner (Name and Address): City of Cottage Grove  
400 East Main Street  
Cottage Grove, OR 97424

Construction Contract:

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

Amount: \_\_\_\_\_

Description (Name and Location): \_\_\_\_\_

Bond:

Date (Not earlier than Construction Contract Date): \_\_\_\_\_

Amount: \_\_\_\_\_

Modifications to this Bond: None, See Page 4

CONTRACTOR AS PRINCIPAL  
Company: \_\_\_\_\_  
(Corporate Seal)

SURETY  
Company: \_\_\_\_\_  
(Corporate Seal)

Signature: \_\_\_\_\_

Signature: \_\_\_\_\_

Name and Title: \_\_\_\_\_

Name and Title: \_\_\_\_\_

(Any additional signatures appear on page 4)

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(FOR INFORMATION ONLY - Name, Address and Telephone)  
AGENT OR BROKER:

OWNER'S REPRESENTATIVE:  
(Architect, Engineer or other Party):

- 1 The Contractor and the Surety, jointly and severally bind themselves, their heirs, executors, administrators, successors and assigns to the Owner for pay for labor, materials and equipment furnished for use in the performance of the Construction Contract, which is incorporated herein by reference.
- 2 With respect to the Owner, this obligation shall be null and void if the Contractor:
  - 2.1 Promptly makes payment, directly or indirectly for all sums due Claimants, and
  - 2.2 Defends, indemnifies and holds harmless the Owner from claims, demands, liens or suits by any person or entity whose claim, demand, lien or suit is for the payment for labor, materials or equipment furnished for use in the performance of the Construction Contract, provided the Owner has promptly notified the Contractor and the Surety (at the address described in paragraph 12) of any claims, demands, liens or suits and tendered defense of such claims, demands, liens or suits to the Contractor and the Surety, and provided there is no Owner Default.
- 3 With respect to Claimants, this obligation shall be null and void if the Contractor promptly makes payment, directly or indirectly, for all sums due.
- 4 The Surety shall have no obligation to claimants under this Bond until:
  - 4.1 Claimants who are employed by or have a direct contract with the Contractor have given notice to the Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to the Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
  - 4.2 Claimants who do not have a direct contract with the Contractor:
    - 4.1 Have furnished written notice to the Contractor and sent a copy, or notice thereof, to the Owner, within 90 days after having last performed labor or last furnished materials or equipment including in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials were furnished or supplied or for whom the labor was done or performed; and
    - 4.2 Have either received a rejection in whole or in part from the Contractor, or not received within 30 days of furnishing the above notice any communication from the Contractor by which the Contractor has indicated the claim will be paid directly or indirectly; and
    - 4.3 Not having been paid within the above 30 days has sent a written notice to the Surety (at the address described in Paragraph 12) and stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to the Contractor.
- 5 If a notice required by Paragraph 4 is given by the Owner to the Contractor or to the Surety that is sufficient compliance.
- 6 When the Claimant has satisfied the conditions of the Paragraph 4, the Surety shall promptly and at the Surety's expense take the following actions:

- 6.1 Send an answer to the Claimant, with a copy to the Owner, within 45 days after receipt of the claim, stating the amounts that are disputed and the basis for challenging any amounts that are disputed.
- 6.2 Pay or arrange for payment of any undisputed amounts.
- 7 The Surety's total obligation shall not exceed the amount of this Bond, and the amount of this bond shall be credited for any payments made in good faith by the Surety.
- 8 Amounts owed by the Owner to the Contractor under the Construction Contract shall be used for the performance of the Construction Contract and to satisfy claims, if any, under any Construction Performance Bond. By the Contractor furnishing and the Owner accepting this Bond, they agree that all funds earned by the Contractor in the performance of the Construction Contract are dedicated to satisfy obligations of the Contractor and the Surety under this Bond, subject to the Owners priority to use the funds for the completion of the work.
- 9 The Surety shall not be liable to the Owner, Claimants or others for obligations of the Contractor that are unrelated to the Construction Contract. The Owner shall not be liable for payment of any costs or expenses of any Claimant under this Bond, and shall have under this Bond no obligations to make payments to, give notices on behalf of, or otherwise have obligation to Claimants under this bond.
- 10 The Surety hereby waives notice of any change, including changes of time to the Construction Contract or to related subcontracts, purchase orders and other obligations.
- 11 No suit or action shall be commenced by a Claimant under this Bond other than in a court of competent jurisdiction in the location in which the work or part of the work is located after the expiration of one year from the date (1) on which the Claimant gave the notice required by Subparagraph 4.1 or Clause 4.2.3, or (2) on which the last labor or service was performed by anyone or the last materials or equipment were furnished by anyone under the Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this Paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.
- 12 Notice to the Surety, the Owner and the Contractor shall be mailed or delivered to the address shown on the signature age. Actual receipt of notice by Surety, the Owner or the Contractor, however accomplished, shall be sufficient compliance as of the date received at the address shown on the signature page.
- 13 When this Bond has been furnished to comply with a statutory or other legal requirement in the location where the construction was to be performed, any provision in this Bond conflicting with said statutory or legal requirement shall be deemed deleted here from and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. The intent is that this Bond shall be construed as a statutory bond and not as a common law bond.
- 14 Upon request by any person or entity appearing to be a potential beneficiary of this Bond, the Contractor shall promptly furnish a copy of this Bond or shall permit a copy to be made.

## 15 DEFINITIONS

- 15.1 Claimant: An individual or entity having a direct contract with the Contractor or with a Subcontractor of the Contractor to furnish labor, materials or equipment for use in the performance of the Contract. The intent of this Bond shall be to include without limitation in the terms labor, materials or equipment and that part of water, gas, power, light, heat, oil gasoline, telephone service or rental equipment used in the Construction Contract, architectural and engineering services required for performance of the work of the Contractor and the Contractor's Subcontractors, and all other items for which a mechanic's lien may be asserted in the jurisdiction where the labor, materials or equipment were furnished.
- 15.2 Construction Contract: The agreement between the Owner and the Contractor identified on the signature page, including all Contract documents and changes thereto.
- 15.3 Owner Default: Failure of the Owner, which has neither been remedied nor waived, to pay the Contractor as required by the Construction Contract or to perform and complete or comply with the other terms thereof.

MODIFICATIONS TO THIS BOND ARE AS FOLLOWS:

(Space is provided below for additional signatures of added parties, other than those appearing on the cover page.)

CONTRACTOR AS PRINCIPAL  
Company:

SURETY  
Company:

Signature: \_\_\_\_\_

Signature: \_\_\_\_\_

Name and Title: \_\_\_\_\_

Name and Title: \_\_\_\_\_

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

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





**STATE OF OREGON**  
**STATUTORY PUBLIC WORKS BOND**

Surety Bond #: \_\_\_\_\_

CB # (if applicable): \_\_\_\_\_

We, \_\_\_\_\_

\_\_\_\_\_, as principal, and business in the State of Oregon, as surety, are held and firmly bound unto the State of Oregon for the use and benefit of the Oregon Bureau of Labor and Industries (BOLI) in the sum of thirty thousand dollars (\$30,000) lawful money of the United States of America to be paid as provided in ORS chapter 279C, as amended by Oregon Laws 2005, chapter 360, for which payment will and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns, jointly and severally, firmly by this agreement.

WHEREAS, the above-named principal wishes to be eligible to work on public works project(s) subject to the provisions of ORS chapter 279C, as amended by Oregon Laws 2005, chapter 360, and is, therefore, required to obtain and file a statutory public works bond in the penal sum of \$30,000 with good and sufficient surety as required pursuant to the provisions of section 2, chapter 360, Oregon Laws 2005, conditioned as herein set forth.

NOW THEREFORE, the conditions of the foregoing obligations are that if said principal with regard to all work done by the principal as a Contractor or Subcontractor on public works project(s), shall pay all claims ordered by BOLI against the principal to workers performing labor upon public works projects for unpaid wages determined to be due, in accordance with ORS chapter 279C, as amended by Oregon Laws 2005, chapter 360, and OAR 839, then this obligation shall be void; otherwise to remain in full force and effect.

The bond is for the exclusive purpose of payment of wage claims ordered by BOLI to workers performing labor upon public works projects in accordance with ORS chapter 279C, as amended by Oregon Laws 2005, chapter 360.

This bond shall be one continuing obligation, and the liability of the surety for the aggregate of any and all claims which may arise hereunder shall in no event exceed the amount of the penalty of this bond.

This bond shall become effective on the date it is executed by both the principal and surety and shall continuously remain in effect until depleted by claims paid under ORS chapter 279C, as amended by Oregon Laws 2005, chapter 360, unless the surety sooner cancels the bond. This bond may be cancelled by the surety and the surety be relieved of further liability for work performed on contracts entered after cancellation by giving 30 days written notice to the principal, the Construction Contractors Board, and BOLI. Cancellation shall not limit the responsibility of the surety for the payment of claims ordered by BOLI relating to work performed during the work period of a contract entered into before cancellation of this bond.

IN WITNESS WHEREOF, the principal and surety execute this agreement. The surety fully authorizes its representatives in the State of Oregon to enter into this obligation.

SIGNED, SEALED AND DATED this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_

Surety by:

Principal by:

\_\_\_\_\_  
(Seal)  
*Company Name*

\_\_\_\_\_  
*Name*

\_\_\_\_\_  
*Signature*

\_\_\_\_\_  
*Signature*

\_\_\_\_\_  
*Title (e.g. Attorney-in-Fact)*

\_\_\_\_\_  
*Title*

**SEND BOND TO: Construction Contractors Board**  
**P.O. Box 14140**  
**Salem, OR 97309-5052**  
**Telephone: (503) 378-4621**

\_\_\_\_\_  
*Address*

\_\_\_\_\_  
*City State Zip*

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## **GENERAL CONDITIONS**

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## **GENERAL CONDITIONS**

**1 – DEFINITIONS.** In the material bound herewith, certain words or expressions shall be understood to have the following meanings:

**1.1 – Bidder.** Any individual, firm or corporation formally submitting a proposal for the work contemplated herein, acting either directly or through an authorized representative.

**1.2 – City.** Wherever the word "City" occurs in these Contract Documents, the term shall signify the incorporated City of Cottage Grove, Oregon, acting through its governing body or authorized employees.

**1.3 – Contractor.** The individual, firm or corporation undertaking the execution of the work under the terms of the Contract and acting either directly or through his or its agents or employees.

**1.4 – Engineer.** The word "Engineer" shall signify the City Engineer of the City of Cottage Grove, acting either directly or through an authorized City employee.

**1.5 – Contract Documents.** The Contract Documents consist of the Instructions to Bidders, General Conditions, the Advertisement for Bids, Project Proposal, all Addenda, Special Provisions, Technical Specifications, the Contract, the Performance Bond, Payment Bond, Public Works Bond, Bid Schedules, and the Plans, all bound herewith. The Contract Documents shall also include the BOLI Prevailing Wage Rate Schedule dated July 1, 2022, the most recent Oregon Standard Specifications for Construction, published by the Oregon Department of Transportation, including all modifications thereof, incorporated into the Contract Documents before their execution; and all Change Orders entered into by mutual agreement between the City and the Contractor.

**1.6 – Work.** Work shall be understood to mean the furnishing of all labor, materials, equipment and other incidentals necessary for the successful completion of the project and obligations imposed upon the Contractor by the Contract.

**1.7 – Latest Edition of Oregon Standard Specifications for Construction.** "Oregon Standard Specifications for Construction" and "Oregon Standard Specifications" shall be understood to mean: the most recent Oregon Standard specifications for Construction, and any modifications thereof.

## **2 - PLANS AND SPECIFICATIONS**

**2.1 – Plans.** The Plans that describe the work to be performed are as tabulated in the Contract. In the event of discrepancies between the Plans and Specifications, the Specifications shall govern, or as otherwise specified in the Special Provisions of the Specifications.

**2.2 – Alteration in Details of Construction.** The Engineer, during the progress of the work may alter any of the details of construction as may be found expedient, or suitable, and such alterations shall not invalidate the Contract nor release the surety, and the Contractor agrees to execute the altered work the same as if it had been part of the original Contract. Any claims for extension of time or payment for extra work involved shall be made by the Contractor at the time that such alterations are authorized. If alterations result in diminishing the quantity of work, they shall not constitute a claim for anticipated profits on the work so dispensed with.

### 3 - THE ENGINEER

3.1 – Engineer's Status. The Engineer shall have general supervision and direction of the work and is the agent of the City to the extent provided in the Contract Documents. The Engineer has authority to stop the work whenever such stoppage may be necessary to insure the proper execution of the Contract.

The Engineer shall, within a reasonable time, make decisions and recommendations on all claims of the City or Contractor and on all matters relating to the execution and progress of the work, on interpretation of the Plans, recommendations for payment, as well as, issue final approval for the work. The City shall finally approve of all such decisions.

3.2 – Unnoticed Defects and Rejected Material. If any portion of the work shall prove defective and not in conformance with the Plans and Specifications, and if such defective or non-conforming work does not, in the opinion of the Engineer, detract from soundness or acceptability, the Engineer, subject to the written approval of the City, shall have full authority to retain such work and make such deductions in the payment to the Contractor as are determined just and reasonable. All other defective or non-conforming work and rejected material shall be removed and replaced at the Contractor's expense. Failure by the Engineer to condemn or reject defective or non-conforming work and materials shall not be construed to imply acceptance of such work and materials.

3.3 – Approval of Shop Drawings & Schedules. The Contractor shall submit one (1) electronic copy or four (4) hard copies of all shop or setting drawings and schedules required for the work of the various trades, and the Engineer shall pass upon them with reasonable promptness, making desired corrections. The Contractor shall make any corrections required by the Engineer, file with him two corrected copies, and furnish such other copies as may be needed. The Engineer's approval of such drawings or schedules shall not relieve the Contractor from responsibility for deviations from the Plans and Specifications unless he has in writing called the Engineer's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings or schedules.

### 4 - THE CONTRACTOR

4.1 – Contractor's Representatives. The Contractor shall at all time during his absence from the work, have a competent superintendent or foreman as his agent on the work, who shall receive instructions from the engineer or his authorized representatives. The superintendent or foreman shall have full authority and responsibility to promptly supply such materials, tools, plant equipment, and labor as may be required.

4.2 – Laws, Permits and Licenses. The Contractor at all times shall observe and comply with all Federal and State laws, City ordinances and regulations in any manner affecting the conduct of the work, and shall further comply with such orders or decrees as exist at present, and those which may be enacted later by bodies or tribunals having any jurisdiction or authority over the work. The Contractor shall indemnify and save harmless the City, its officers and employees against the claim or liability arising from the violation of any such laws, ordinances, regulations, orders or decrees, whether such violation be by the Contractor, his Subcontractors or his employees.

The Contractor shall procure all permits and licenses, pay all charges and fees and give all notices necessary and incidental to the due and lawful prosecution of the work.

4.3 – Protection of Property and Persons. In the performance of the work to be done under the Contract, the Contractor shall use every reasonable means to avoid damage to property, injury to persons and loss, expense, inconvenience, and delay to the City, users, and others. He shall provide protective devices wherever and whenever needed in affording this protection and, in the performance of the work, he shall use no means or methods which will endanger either persons or property. He shall further comply with all Federal, State and Local Codes relating to the safety and protection of his employees.

All damages and injury to property that may be caused by or that may result from the carrying out of the work to be done under the Contract or from any act, omission, or neglect of the Contractor, shall promptly be made good by the Contractor either by repairing, rebuilding or replacing of the property damaged.

4.4 – Furnishing of Material. Unless otherwise specified in the Special Provisions, all material furnished in connection with the work shall be new and first quality.

4.5 – Inspection of the Work. The Engineer or his representatives shall be allowed access to all parts of the work at all times and shall be furnished with every reasonable facility for ascertaining whether or not the work as performed is in accordance with the requirements and intent of the Plans and specifications. The Contractor shall cut and replace with new materials, at his own expense, such samples as are customarily required for testing purposes. The Contractor shall, at any time before acceptance of the work, remove or uncover such portions of the finished work as may be directed. After examination, the Contractor shall restore said portions of the work to the standard required by the Specifications. Should the work thus exposed or examined prove acceptable, the uncovering or removing, and the replacing of the covering or the making good of the parts removed, shall be paid for as "extra work", but should the work so exposed or examined prove unacceptable, the uncovering or removing, and replacing of the covering and the making good of the parts removed, shall be at the Contractor's expense.

4.6 – Subcontractors. Nothing in these Contract Documents shall be construed to imply a contractual relationship between the City and any Subcontractor engaged by the Contractor. The Contractor agrees that he is fully responsible to the City for all acts of his Subcontractors, material suppliers, employees and indirect employees.

4.7 – Responsibility for Damages. The Contractor shall be responsible for all loss, expense, inconvenience and delay that may be caused by or that may result from any act, omission or neglect of the Contractor in the performance of the work to be done under the Contract. The Contractor shall indemnify and save harmless the City and its officers and employees from all claims, demands, suits or actions of every name and description brought for or on account of any damage, injury, loss, expense, inconvenience or delay received or sustained, or claimed to be received or sustained, by any person or persons, which damage, injury, loss, expense, inconvenience, or delay may have been caused by or may have resulted from the performance of the work to be done under the Contract.

4.8 – Responsibility for the Work. Until final acceptance of the Contract, the Contractor shall be held responsible for any injury or damage to the work or to any part thereof by the action of the elements, or from any cause whatsoever, and he shall make good at his own expense all injuries or damages to any portion of the work before its completion and final acceptance.

4.9 – Taxes. The Contractor shall withhold all Federal, State and local taxes from wages, make all Social Security payments, and pay all taxes, charges and fees which are now or may hereafter be charged.

4.10 – Performance, Payment, and Public Works Bonds. The Contractor shall furnish surety bonds in amounts equal to the total amount of the Contract, as set forth in the Bidder's Proposal as satisfactory to the City. The bonds shall be on the forms bound herewith and shall remain in full force for one (1) year after conditional acceptance of the work, to cover all guarantees against defective workmanship and materials and to insure payment to all person supplying labor or materials in connection with the Contract.

Pursuant to Senate Bill 477, the Contractor shall be required have a Public Works Bond filed with the Construction Contractors Board (CCB) prior to the start of work on any Public Works project, unless exempt. The Contractor shall also require every Subcontractor to have a Public Works Bond filed with the CCB prior to starting work on a project, unless exempt. In addition, the Contractor shall provide proof to the City of Cottage Grove that a Public Works Bond and Public Works Bonds covering all Subcontractors have been filed with the Construction Contractors Board.

4.11 – Insurance. Prior to the start of the work under the Contract, the Contractor shall furnish the City with satisfactory proof of hold-harmless, insurance and related requirements for both work in progress and completed operation as follows:

A. General. In order to protect the financial assets and interests of the City of Cottage Grove and to clarify responsibility and liability between the City and the Contractor, the following procedures, language and conditions shall apply to the work and are hereby incorporated in the contract as if set out in full therein.

B. Hold-Harmless and Indemnification Requirements. To the fullest extent of the law, the Contractor will defend, indemnify, hold harmless and reimburse the City of Cottage Grove (including its officers, Council members, agents and employees) from all claims, demands, suits, actions, penalties, damage expenses for liability of any kind) including attorney's fees. To the extent that death or bodily injury to persons or damage to property arises out of the fault of the Contractor, the Contractor's indemnity obligation exists only to the extent it contributed to or caused such damage, whether or not such are contributed to or caused in any part by the City of Cottage Grove.

C. General Insurance Requirements. The Contractor shall maintain in force for the duration of this agreement a Commercial General Liability insurance policy written on an occurrence basis with limits not less than \$1,000,000 per occurrence and \$2,000,000 in the aggregate. Automobile Liability (owned, non-owned and hired) insurance with limits not less than \$1,000,000 per occurrence shall be maintained. The City, its employees, officials and agents will be named as additional insured with respect to work or services performed under this agreement. This shall apply to both work in progress and completed operations. This insurance will be primary over any insurance the City may carry on its own.

D. Builder's Risk Insurance. If so specified in the Contract Documents, the Contractor shall maintain an all risk insurance policy covering the replacement cost of the work during the course of construction. The policy shall include the interest of the City and the design architect or engineer. The amount of the insurance shall equal the completed value of the contract amount.



E. Worker's Compensation Insurance. The Contractor shall provide and maintain worker's compensation coverage for its employees, officers, agents or partners, as required by applicable Worker's Compensation laws.

F. Evidence of Insurance Coverage. Evidence of the above coverages issued by a company satisfactory to the City of Cottage Grove shall be provided to the City by way of a certificate(s) of insurance prior to the commencement of any work or services. A 30-day notice of cancellation or material change in coverage clause shall be included. Company will mail a 30-days written notice of change in coverage. Failure to maintain the proper insurance shall be grounds for immediate termination of this contract.

G. Equipment and Material. The Contractor shall be responsible for any loss, damage or destruction of its own property, equipment and materials used in conjunction with the work.

H. Subcontractors Insurance Requirements. The Contractor shall require all Subcontractors to provide and maintain general liability, auto liability, professional liability (where applicable) and worker's compensation insurance with coverages equivalent to those required of the general Contractor in this contract. The Contractor shall require certificates of insurance from all Subcontractors as evidence of coverage.

4.12 – Guarantee. The Contractor shall guarantee all work and materials furnished under the Contract for a period of one (1) year after conditional acceptance and he shall, at his own proper expense, repair and replace any such defective materials and workmanship to the satisfaction of the Engineer, and shall hold the City harmless from all claims arising from defective materials, and workmanship. Nothing herein contained, to furnish materials and workmanship in accordance with Plans and Specifications as herein provided, may be changed without written authorization of the City.

4.13 – Liens and Claims. The Contractor shall not permit a lien to be filed against the works, and prior to final payment for the work performed under the Contract, the Contractor shall furnish the City with an affidavit stating that all claims on labor, services or materials have been settled and filed with the City, the Contractor shall promptly refund to the City all monies that the City may have been compelled to pay in satisfying such liens, including attorney's fees and costs.

## 5 - PROSECUTION AND PROGRESS OF THE WORK

5.1 – Prosecution of the Work. The work to be done under the Contract shall not be commenced until the Contract, the Performance and Payment Bonds, the Public Works Bond, and Insurance Certification have been executed by the Contractor and his surety and delivered to the City. Performance of the work to be done under the Contract shall be commenced within ten (10) calendar days after the Contractor has been issued a Notice to Proceed.

After the award of the Contract and prior to the work commencing, the Contractor shall meet and consult with the Engineer on the Contractor's proposed arrangements for the prosecution of the work and timing schedules for the various phases of the work. It is agreed by the Contractor that time is the essence of the Contract; and from the time of commencement of the work to the time of completion; the work shall be prosecuted vigorously and continuously, and always in accordance with a schedule which will insure completion within the specified time limit.

5.2 – Character of Workman and Equipment. The Contractor shall employ only competent and efficient laborers, mechanics or artisans; and whenever, in the opinion of the Engineer, any

employee is careless or incompetent, or obstructs the progress of the work, or acts contrary to instructions or conducts himself improperly, the Contractor shall, upon written complaint of the engineer, discharge or otherwise remove him from the work and not employ him again on it. The methods, equipment and appliances used and the quantity and quality of the personnel employed on the work shall be such as will produce a satisfactory quality of work and shall be adequate to complete the Contract within the time limit specified.

5.3 – Time of Completion and Liquidated Damages. Inasmuch as delay in the prosecution of the work will inconvenience and increase the cost to the City, it is essential that the work be pressed vigorously to completion. Therefore, the work to be done under the Contract shall be completed in its entirety before the elapse of the number of calendar days stated in the Contract. Recording of the elapse of the calendar days will begin with the tenth (10) calendar day following the date of the notice to proceed.

A calendar day is hereby defined as every day, except legal holidays, as designated by the State of Oregon, on which the Contractor is not prevented, by conditions resulting from inclement weather, or by suspension of work ordered by the Engineer or specifically required by provisions of the Contract or by acts of God from performing work under the Contract with daily productiveness equal to at least fifty (50) percent of the daily productiveness normally possible at the same stage of construction under favorable conditions. The relative productiveness as determined by the Engineer shall be conclusive.

It is agreed by the parties to the Contract that, in case all the work called for under the Contract in all parts and requirements, is not finished or completed within the number of calendar days called for in the Contract, damage will be sustained by the City, and that it is and will be impracticable and extremely difficult to ascertain and determine the actual damage which the City will sustain in the event of and by reason of such delays; and it is therefore agreed that the Contractor will pay to the City as liquidated damages or the City at its option, may deduct from any monies due or to become due to the Contractor from the City, the sum indicated in the schedule shown for each and every calendar day elapsed in excess of the number of calendar days specified for the performance and completion of the work called for in the Contract.

The parties further agree that this amount of liquidated damages is a reasonable forecast of just compensation for the harm caused by any breach and that this harm is one which is impossible or very difficult to accurately estimate.

Schedule of Liquidated Damages

Total Amount of Contractor's Bid	Per Diem of Liquidated Damages
\$75,000 and over	\$500.00 per calendar day in excess of calendar days specified.
\$75,000 and over	\$1,000.00 per calendar day in excess of the allowable outage duration as described the Contract Documents

Permitting the Contractor to continue and finish the work or any part thereof after the time or number of calendar days fixed for its completion, including any increase in calendar days which may have been granted as hereinafter provided, shall in no way operate as a waiver on the part of the City of any of its rights under the Contract.

Payment of liquidated damages shall not release the Contractor from obligation in respect to the fulfillment of the entire Contract, nor shall the payment of such liquidated damages constitute a waiver of the City's right to collect any additional damages which it may sustain by failure of the Contractor to carry out the terms of his Contract, it being the intention of the parties that said liquidated damages be full and complete payment only for failure of the Contractor to complete the work on time.

5.4 – Increase in Time for Performance of Contract. Temporary suspension of work and delays, occasioned by errors or changes in the Plans and Specifications of the Contract or failure of the City, its employees and its other Contractors to act promptly in carrying out obligations and duties shall be considered causes for increasing the number of calendar days specified for the completion of the work without assessment for liquidated damages, to the extent only that said causes actually increase the number of calendar days required for completion of the work to be done under the Contract.

Shortage or inadequacy of labor or equipment, or failure to supply the necessary materials, shall not be considered to be beyond the Contractor's control, and delays resulting there from shall not be considered cause for increase in the number of calendar days specified for the completion of the work.

In the event the Contractor is prevented from completing the work to be done within the number of calendar days, specified for completion by reason of one or more of the causes set forth above only, the Contractor may request the City to increase the number of calendar days specified for the completion of the work without assessment of liquidated damages. The request shall be in writing, shall set forth in full the conditions which have delayed or prevented completion of the work, shall state the dates of the calendar days during which prosecution of the work was actually prevented by such conditions. The decisions of the City as to whether and to what extent an increase in the number of calendar days for completion of the work without assessment of liquidated damages shall be granted shall be final.

5.5 – Cancellation of Contract by the Owner. If the Contractor should be adjudged as bankrupt, or if he should make a general assignment for the benefit of his creditors, or if a receiver should be appointed on account of his insolvency, or if he should persistently refuse or should fail to supply enough properly skilled workmen or proper materials for the efficient prosecution of the project, or if he should fail to make prompt payment to Subcontractors or for material or labor, or persistently disregard laws, ordinances or the instructions of the Engineer or otherwise be guilty of a substantial violation of any provision of the Contract, then the City, upon the certificate of the Engineer that sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor and his surety seven (7) days written notice, terminate the employment of the Contractor, and require the surety to complete the Contract. In the event action as above is taken by the City, the Contractor shall not be entitled to receive any further payment and payments due shall be made directly to the surety; and upon completion of the work by the surety, the surety will be entitled to receive an amount equal to the difference of the sum of amounts previously paid to the Contractor and the amount the Contractor would have been entitled to receive for the work, under the terms of the Contract, had he himself completed the work.

In lieu of the above, the City may, if it so elects, take possession of the premises and of all materials, tools and appliances thereon and finish the work by whatever method the City may deem expedient. In such cases the Contractor shall not be entitled to receive any further payment until the work is finished. If the unpaid balance of the Contract price shall exceed the expense of

finishing the work including compensation for additional managerial and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor shall with the surety's guarantee, pay the difference to the City. The expense incurred by the City, as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Engineer.

5.6 - Use of Premises by the City. The City reserves the right to enter upon the premises, to use same, and to let other contracts in connection with this Contract, or to use parts of the work of the Contractor before the final completion of the work, it being understood that such use by the City in no way relieves the Contractor from full responsibility of his obligations in completing his Contract. Taking possession of completed or partially completed portions of the work shall not constitute acceptance of any work not completed in compliance with the Contract Documents. The Contractor shall be entitled to extra compensation and/or an increase in the time limit if the Engineer determines that such possession by the City increases the Contractor's costs and delays the work.

5.7 – Cutting and Patching. The Contractor shall do all cutting, fitting or patching of his work that may be required to make its several parts come together properly and fit it to receive or be received by work of other Contractors or existing facilities, as shown upon or reasonably implied by the Plans and Specifications for the completed structure, and he shall make good after them as the Engineer may direct. The Contractor shall not endanger any work by overloading, cutting, digging, or otherwise, and shall not alter the work of any other Contractor without the consent of the Engineer.

5.8 – Cleanup by Contractor. The Contractor shall at all times keep the premises free from accumulations of waste material or debris caused by his employees or work materials, and leave the work in a neat condition satisfactory to the City. The project area shall be cleaned up within two (2) weeks of the final acceptance of the project by the City.

## 6 – PAYMENT FOR THE WORK

6.1 – Application for Payments by the Contractor. Partial payments shall be made in accordance with ORS 279.435 to ORS 279C.570 and shall be due the Contractor not later than 30 days after receipt of the invoice, for work performed during the preceding calendar month. Five (5) percent (%) of the amount invoiced will be retained out of progress payments as allowed under this statute.

The Contractor shall submit to the City an application for each payment, and if required, receipts or other vouchers showing his payment for materials and labor, including payments to Subcontractors. Such application shall be submitted at least thirty (30) days before each payment falls due and if required, the Contractor shall submit with the application to the City a schedule of values of various parts of the work upon which payment is requested.

No certificate issued or payment made to the Contractor shall be an acceptance of any work or materials not in accordance with the Contract. Five (5) percent of all monies earned by the Contractor will be retained no more than thirty (30) days after the date upon which the City accepts the work covered by the Contract, as evidenced by the Engineer's final inspection and recommendation of acceptance.

6.2 – Extra Work. Extra work shall not be performed by the Contractor, except in an emergency endangering life or property, unless it is in pursuance of a written supplemental

agreement, signed by the City. No claim for an addition to the Contract price shall be valid unless the extra work involved has been ordered by supplemental agreement, with the amount of the extra claim established prior to the execution of the extra work.

6.3 – Suspension of Payments. No partial or final payment shall be made as long as any order made by the Engineer to the Contractor in accordance with the Specifications remains un-complied with. Neither shall any partial or final payment be made as long as any claim of lien filed or prosecuted against the City, contrary to the provisions of the Contract remains unsatisfied.

6.4 – Substantial Completion and Final Inspection. When the Contractor considers that the Work is substantially complete, the Contractor shall notify the City in writing. Upon receipt of the notification, the City and/or their authorized representatives will make an inspection, to determine if the Work and administrative requirements are sufficiently complete in accordance with the Contract Documents so the City can occupy or utilize the Work for its intended use. If items are found which prevent such use or occupancy, the City shall notify the Contractor in writing of such items by issuing a Corrective Work Item List.

Unless otherwise provided, the City shall make a final inspection of all work included in the Contract within ten (10) days after notification by the Contractor that the items on the Corrective Work Item List have been addressed and the work is completed. If the work is not acceptable to the City, he shall advise the Contractor as to the particular defects to be remedied before final acceptance can be made. When, in the opinion of the City, the work is acceptable and has been completed in accordance with the Contract, the Engineer shall file a Certificate of Completion with the City. Neither the final certification nor the final Payment nor any provision of the Contract Documents shall relieve the Contractor of his responsibility for defective material and workmanship for the length of, and to the extent of his guarantee as provided under Item 4.12 of these General Conditions. The failure or neglect on the part of the Engineer to condemn unsatisfactory material or to reject inferior workmanship shall in no way releases the Contractor, nor shall the Engineer's acceptance thereof be construed to mean the acceptance of such unsatisfactory work or material, and no payment therefore shall be construed as an acceptance of defective work or improper materials under the provisions of the Contract Documents.

6.5 - Final Payment. As soon as practicable after the completion and acceptance of the work under the Contract, as evidenced by the Engineer's certificate of completion, the Engineer will prepare a final estimate of the total amount earned by the Contractor in accordance with the terms of the Contract and all supplemental agreements. Following this determination of the total amount earned by the Contractor, and final acceptance of the work by the City, final payment shall be made to the Contractor. All prior estimates and payments shall be subject to correction in the final estimate and payment.

The acceptance by the Contractor of final payment shall be and shall operate as a release to the City of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this work and for every act and neglect of the City and others relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the Contractor or its sureties from any obligations under the Contract Documents or the Performance, Payment, and Public Works Bonds.

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## **PREVAILING WAGE RATES**

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## **PREVAILING WAGE RATES**

### **CLARIFIER PHASE 1**

In accordance with ORS 279C.800 et seq., copies of the general prevailing rate of per diem wages in the locality have been determined by the Commissioner of the Bureau of Labor. The July 1, 2022 Prevailing Wage Rates for Public Works Projects in Oregon are hereby incorporated as part of the contract documents. Such publications can be reviewed electronically at:

<https://www.oregon.gov/boli/WHD/PWR/July%202019/July%201%2c%202019%20PWR%20Rate%20Book.pdf>

It shall be mandatory for the Contractor and all Subcontractors to pay not less than the applicable prevailing rates for each craft, classification or type of worker.

As a condition of this contract the Contractor and all Subcontractors shall file with the City completed copies of the "Payroll/Certified Statement Form WH-38".

#### **FORM WH-81 "NOTICE OF AWARD OF PUBLIC WORKS CONTRACT"**

In accordance with ORS 279C.385 the contracting agency is required to submit a copy of this form to the Bureau of Labor within thirty (30) days after the public works contract is awarded.

#### **FORM WH-38 "PAYROLL/CERTIFIED STATEMENT"**

This form will be provided to the prime Contractor at the time the contract is awarded with instructions to the prime Contractor to provide copies of the form to every Subcontractor on the project. Contractors may use their own forms to submit payroll information, but they must attach this revised WH-38 with the completed shaded agency information together with the signed certified statement information on the back.

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**SPECIAL PROVISIONS: GENERAL**

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## **SPECIAL PROVISIONS: GENERAL**

### **SECONDARY CLARIFIER 1 EQUIPMENT REPLACEMENT**

#### **G-01 WORK INVOLVED**

The project consists of the construction of the following work and all work incidental thereto, as set forth in the project plans and specifications:

- Replacement of Secondary Clarifier 1 Equipment
- New concrete center foundation
- Miscellaneous structural concrete repairs
- Replacement of the existing handrail
- Replacement of small diameter piping
- Associated structural, mechanical, electrical and instrumentation and control improvements.

#### **G-02 COMMENCEMENT AND COMPLETION OF WORK**

Work shall be commenced by the Contractor in accordance with Section 5 of the General Conditions and shall be completed in all respects within one hundred and ninety-four (194) calendar days, excluding holidays.

The Contractor shall submit a detailed schedule of work indicating contemplated commencement and completion dates for each of the major items of work to the Engineer for approval.

In accordance with Section 00180.70 of the most recent Oregon Standard Specifications for Construction, except as herein specified, the Engineer will have the authority to suspend the work wholly or in part for cause including but not limited to conditions considered unsuitable for the performance of the work. Such suspension shall not be cause for additional or extra compensation to the Contractor.

Protection of the work: The Contractor shall be fully responsible for protecting all portions of his work during the life of this contract including suspensions thereof and until acceptance of the contract work, except as follows:

1. If the Contractor has wholly completed all the planned work between specific limits and to the satisfaction of the Engineer, the Contractor may request that a partial relief from maintenance be granted to him by the City for the completed portion only. Upon the request of the Contractor, the Engineer may relieve him of the duty of maintaining and protecting certain portions of the work as described below, which have been completed in all respects in accordance with the requirements of the contract and to the satisfaction of the Engineer, and thereafter except with his consent, the Contractor will not be required to do further work thereon except for any defects in workmanship or materials.

The warranty period of one (1) year will begin at the time the City accepts the maintenance responsibility on a completed section of work only. In addition, such action

by the Engineer will relieve the Contractor of responsibility for any injury or damage to said completed portions of the work resulting from use by public traffic or from the action of the elements or from any other cause but not from injury or damage resulting from the Contractor's own operations or from his negligence.

Nor shall anything contained herein relieve the Contractor or his surety of any public liabilities or claims relating to or resulting from the contract as a whole.

2. No extra or additional compensation will be paid to the Contractor for the protection of his work during the life of this contract including suspensions thereof.

Maintenance during suspensions shall be in accordance with Section 00180.70 of the Oregon Standard Specifications for Construction, 2016, except as herein specified. If the suspension of the work is due to the winter seasonal conditions, the Contractor shall place in a maintainable condition any completed portion of the road bed, connecting roads, detours and driveways as are necessary to accommodate traffic as directed by and to the satisfaction of the Engineer. The Contractor shall maintain such facilities on a regular basis during the suspension of the work and as otherwise directed by the Engineer. All costs related to constructing and maintaining the roadway in an acceptable manner to accommodate traffic during such a suspension shall be borne by the Contractor and no additional compensation shall be made therefore. Costs to be borne by the Contractor shall include, but not be limited to placing and removing temporary facilities, restoration of the work area following suspensions; any costs relating to shut down, idle equipment or labor, together with costs of remobilization and startup.

In the event work is suspended by the Engineer, such work shall remain suspended until the Engineer authorizes in writing that the work may proceed. The Contractor shall recommence the work within ten (10) days of receiving such written authorization.

There shall be no additional compensation paid due to any inflation of costs incurred by the Contractor for materials, labor or equipment used in the work during the life of this contract or suspension thereof for the time specified herein.

#### **G-03 FAILURE TO COMPLETE THE WORK IN THE TIME AGREED UPON**

It is agreed by the parties to the contract that failure to complete the work or any part thereof in the time agreed upon in the contract, or within such extra time as may have been allowed for delays or extensions granted as provided in the contract, will cause damage to the City of Cottage Grove, and that it is actual damage which the City will sustain the event or and by reason of such delay, and it is therefore agreed that the Contractor will pay to the City of Cottage Grove the sum determined from Section 5.3 of the General Conditions, for every day including Saturdays, Sundays and holidays that the contract remains uncompleted after the date required for completion, and it is agreed that said amounts will be deducted from any money due the Contractor under his contract and the Contractor and his sureties shall be liable for any excess.

#### **G-04 PERIODIC PAYMENTS**

The Contractor shall submit a monthly estimate of the work performed together with an invoice by the last day of each calendar month for ninety-five (95) percent of the value of the work performed through the last day of that same calendar month, less the aggregate of previous

payments, based on accepted unit prices in the bid proposal. The estimate of work performed shall be reviewed by and subject to the approval of the Engineer. The invoice amount will be paid in accordance with Section 6.1 of the General Conditions following approval of the Engineer. Quantities used in computing partial payments shall be considered as estimates only and shall be subject to revisions in following estimates. Work completed as estimates shall be an estimate only and no inaccuracy or error in said estimate shall operate to release the Contractor or any bondsman from damages arising from such work or from the enforcement of each and every provision of this contract, and the City shall have the right subsequently to correct any error made in any previous estimate for payment. Materials delivered but not incorporated or installed in the work, will not be included in progress estimates and/or payments. The Contractor shall not be entitled to receive any monthly payments under this section of the specifications as long as any lawful or proper direction concerning the work or any portion thereof, given by the City Engineer shall remain un-complied with.

The work shall be constructed in accordance with a set of plans entitled "CLARIFIER PHASE 1" and the Special Provisions and Technical Specifications and in accordance with the most recent Oregon Standard Specifications for Construction published by Oregon Department of Transportation.

#### G-05 SPECIFICATIONS AND PLANS

The order of precedence will be as follows: Special Provisions, Technical Specifications, Project Plans, and the most recent Oregon Standard Specifications for Construction, and any modifications thereof.

The official project plans and standard plans, profiles, typical cross sections, working drawings and supplemental drawings, or reproductions thereof, approved by the Engineer, which show the location, character, dimensions, and the details of the work to be performed are to be considered as a part of the plans and the contract whether or not reproduced in these specifications.

#### G-06 SUBCONTRACTORS

Subcontractors must be qualified to perform that portion of the work which they perform.

It is the intention of this contract and of the City that not more than fifty (50) percent of the work shall be subcontracted. Any subcontract shall contain a reference to the agreement between the City and the principal Contractor and the terms of that agreement and all parts thereof shall be made a part of such subcontract insofar as applicable to the work covered thereby. All work or material furnished by a Subcontractor shall be guaranteed by the Contractor and the Contractor shall be responsible therefore.

The Contractor shall be required to perform a minimum of fifty (50) percent of the work with his own forces and employees. The Contractor shall be responsible for the satisfactory completion of all items of work whether performed by his own forces or by subcontract.

Nothing in these Contract Documents shall be construed to imply a contractual relationship between the City and any Subcontractor engaged by the Contractor. The Contractor agrees that it is fully responsible to the City for all acts of his Subcontractors, material suppliers, employees and indirect employees.

#### G-07 SUPERINTENDENCE

The Contractor shall keep on this work, during its progress, a competent superintendent and any necessary assistants, all satisfactory to the Engineer. The superintendent shall not be changed except with the Engineer's consent unless the superintendent proves to be unsatisfactory to the Contractor or otherwise ceases to be in his employ. The superintendent shall represent the Contractor in his absence and all directions given to him shall be binding as if given to the Contractor. The Contractor shall furnish the Engineer the names and telephone numbers of two responsible employees, one of whom may be reached at all times that the work is not in progress, to be called in case of any emergency on the work.

#### G-08 WORK LIMITS

The Contractor shall confine all his operations to within City of Cottage Grove Wastewater Treatment Plant site as shown on the plans, except as may be otherwise approved by the Engineer.

Stockpiling of materials and storage of materials and equipment on property other than the City of Cottage Grove's shall be subject to the written approval of the property owner and submitted to the Engineer. All related restoration work on public right-of-way and private property shall be performed in a good and workmanlike manner.

#### G-09 SCHEDULE AND COORDINATION OF WORK

The Contractor shall submit a detailed schedule of work indicating contemplated Commencement and completion dates for each major item of work.

All work shall be scheduled and performed in such a way as to cause a minimum of inconvenience to the public. Once any item of work is begun it shall be diligently and continuously pursued to completion.

The Contractor's proposed project schedule will be reviewed and approved or returned for revisions within five (5) days after receipt by the Engineer.

If required by the Engineer, the Contractor shall submit supplementary progress schedules which shall be in the form described above to indicate the approximate percentage of work scheduled for completion at any time.

The approved schedule of work shall be complied with, unless otherwise approved in writing by the Engineer.

#### G-10 TRAFFIC CONTROL AND DETOURS DURING CONSTRUCTION

Vehicle traffic through the work area shall be permitted to the fullest extent possible. One lane of traffic shall be open at all times.

During all non-operational hours the Contractor shall maintain foot and vehicle traffic free of obstructions and open to public travel as much as possible in and around the work area. Advance warning and advisory signs shall be required around the working area.



The Contractor shall coordinate directly with the Engineer or his representative for the purpose of advising them of scheduled construction and reducing impact on owner's access.

To the fullest extent possible during construction and during all non-operational hours, the Contractor shall maintain access to all driveways, sidewalks and parking areas in the vicinity of construction. At the end of each day's operations, the Contractor shall provide safe and adequate access to all driveways and parking areas all to the satisfaction of the Engineer and no additional compensation will be made therefore.

#### G-11 CONTRACTOR'S TRAFFIC AND MATERIALS DELIVERY

All of the Contractor's traffic using various streets and highways shall be within the statutory requirements of the State of Oregon. To the fullest extent possible the Contractor's traffic shall enter and exit the work areas by the most direct routes, all to the satisfaction of the Engineer. The City selects specific haul routes based upon the project location.

Tracked equipment shall not be driven on City Roads, but will be transported to the site by a rubber-tired vehicle designed for such use.

Streets, which become dirty as a result of the Contractor's operations and hauling of materials shall be thoroughly cleaned and/or flushed by the Contractor as directed by the Engineer.

The costs related to complying with these requirements shall be included in the various bid items of this contract and no additional compensation will be made therefore.

#### G-12 CONSTRUCTION WATER

Construction water will be made available at no charge to the Contractor from a fire hydrant, which has been approved by the Engineer located within the Cottage Grove City Limits. The Contractor shall furnish, install and maintain an approved hydrant valve for the taking of water. The Contractor shall be responsible for operating, maintaining and protecting the hydrant assembly for the duration of its use.

The furnishing, hauling and placing of water is not a pay item and the entire work of street cleaning, and other construction uses shall be at the expense of the Contractor. Street cleaning shall also extend to adjacent streets used by the Contractor.

All of the Contractor's costs involved in furnishing, hauling and applying water shall be included in the prices bid for the various bid items and no separate compensation will be made therefore.

#### G-13 DAMAGE TO PROPERTY

Any property including existing structures, signs, equipment, piping, pipe covering, landscaping, grounds, irrigation systems, sidewalks, curbs, gutters, driveways, etc., damaged by the Contractor during the course of his work shall be replaced or repaired by the Contractor in a manner satisfactory to the Engineer and at the Contractor's expense.

#### G-14 PROTECTION OF WORK

Contractor shall be responsible for any damage to any work covered by these specifications before the final acceptance of his work. Contractor shall securely cover all openings into the

drainage, water and sanitary systems and cover all apparatus, equipment and appliances, both before and after being set in place to prevent damage, breakage, misuse or disfigurement of any work, materials or equipment.

#### G-15 DISPOSAL OF MATERIALS

All broken Portland Cement Concrete, asphalt concrete, vegetation, excess earth, debris, street sweepings and other unsuitable materials shall be removed from the job site and disposed of by the Contractor all to the satisfaction of the Engineer. The Contractor shall be responsible for providing his own disposal site at his own expense. The Contractor shall acquire written permission from the owner of any disposal site selected by the Contractor that is within the Urban Growth Boundary of the City of Cottage Grove. A copy of that written permission shall be furnished to the Engineer for approval. All costs related to disposal sites, scheduling, hauling, etc. shall be compensated for under the bid items of this contract and no separate compensation shall be made therefore.

#### G-16 INSPECTION AND TESTING

All work shall be to the satisfaction of the Engineer.

Testing shall be as specified in the Technical Specifications.

The Contractor shall notify the Engineer forty-eight (48) hours in advance of the time work shall start.

The Contractor shall inform the City Engineer well in advance of the work as to the source of all materials proposed to be used in the work. Samples of materials shall be made available for testing as required by the Engineer, prior to starting work and during the course of the work. The Contractor shall have no cause for claim against the City for delays involved in the testing of materials or the evaluation of such test and no compensation will be made therefore. Cost of initial testing of materials, other than testing required as part of the Technical Specifications contained herein, shall be borne by the City. In the event of any failing test, the cost of retesting shall be borne by the Contractor.

#### G-17 MATERIAL AT JOB SITE

The Contractor shall notify the Engineer well in advance of bringing any materials on the job so that they may be checked or tested for compliance with specifications.

Materials brought on the site without prior acceptance may be ordered off the work and the Contractor will not be entitled to any time extension or remedy for time lost while waiting for, making and obtaining of tests.

Materials for which the source was approved but which do not conform to specifications when delivered at the job may be rejected. When doubt as to compliance with specifications exists, compliance with specification will be checked by test and the decision by the City Engineer as to the suitability of the material will be final.

#### G-18 CERTIFICATES OF COMPLIANCE

The suppliers of the following items shall, prior to the work, certify that each item is in full compliance with the City of Cottage Grove Specifications for "CLARIFIER PHASE 1" project and the most recent Oregon Standard Specifications for Construction:

- Crushed Aggregate Base, Bedding, and Backfill Materials
- Asphalt Concrete and Emulsions
- Liquid Asphalt
- Pavement Marking Materials (Paint & Thermoplastic)
- Manhole materials

#### G-19 LINES AND GRADES

Initially the Engineer will provide lines and grades to the extent deemed necessary by the Engineer for the construction.

It shall be the Contractor's responsibility to see that the finished work conforms to the lines, grades, and benchmarks given by the Engineer. The Contractor shall establish supplementary benchmarks, elevations, lines and grades, and any other necessary horizontal and vertical controls which are not established by the Engineer and which are necessary to complete the earth work and finished grading of subgrade, aggregate base, sidewalk areas, slopes and ditches. The cost to the Contractor for laying out the work as described shall be included in the prices bid for the various scheduled items. The Contractor shall exercise care in the preservation of stakes and benchmarks set for his or the Engineer's use. If any such stakes or benchmarks are damaged, lost, displaced, or removed by the Contractor or by others, the Contractor shall have them reset at his expense or the City will have it done and the cost thereof will be billed to the Contractor at the actual hourly or per diem rates.

#### G-20 SANITARY FACILITIES

The Contractor shall provide on-site restroom facilities for employees. Such facilities shall be maintained in a clean and sanitary condition. The cost of sanitary facilities shall be included in the various bid items and no other compensation will be made therefore.

#### G-21 CHANGES AND EXTRA WORK

The City reserves the right to require changes or extra work and the Contractor shall perform such changes or extra work upon written authorization and specifications as to the amount and method of compensation as hereafter provided.

The City also reserves the right to adjust the amount of work based on available funds.

A. What constitutes a "change" or "extra work"?

1. A variation between estimated and actual quantities of work or material required to construct a project in accordance with the Plans and Specifications as they exist at the time the bids are opened, does not constitute a change or extra work; does not require additional authorization, and the said quantities shall be paid for at the unit or lump sum prices established in the bid.

2. A variation between definite quantities of work or material specified in the Plans and Specifications as they exist at the time bids are opened and upon which quantities unit

prices are bid and the quantities required under revised or modified Plans and Specifications, is a change.

3. The furnishing of material or performance of work for which unit prices have been bid on the basis of estimated quantities, but which materials or work is required to be done under revised or modified Plans and Specifications, is a change.

4. Revisions or modifications of the Plans and Specifications such as, but not limited to, those affecting designs or materials, installation of construction, shapes, dimensions or locations are changes.

5. Supplying work or material for which no unit prices have been bid and which are not included in the Plans and Specifications as they exist at the time bids are opened but which are required under revised or modified Plans and Specifications is extra work.

6. Contract time extensions requested by the City of Cottage Grove.

B. Contractor shall not be entitled to any additional compensation for change or extra work unless the same has been authorized in writing (hereafter referred to as "change order" or "order for extra work") which describes the change or extra work to be done and the amount and method of compensation therefore hereafter provided. No change order or order for extra work shall be valid unless dated and signed by the Contractor (or by his agent previously authorized in writing delivered to the City to execute said change order or order for extra work) and the authorized representative of City as hereafter provided.

C. Amount and method of compensation.

1. The quantities shown in the schedule of items are estimates only. Payment will be made for the actual quantity of work completed in accordance with these Specifications. The unit bid prices shall apply to all quantities within plus or minus 25 percent of the estimated quantities. Quantities in excess of the 25 percent variation shall be considered as a change and may be subject to adjusted unit prices.

2. When a variation is made for which no bid items were specified, compensation therefore shall be at unit prices or lump sum agreed to by the parties.

3. In the event that unit prices or a lump sum cannot be agreed to, then compensation shall be computed on a "cost plus" basis as follows:

D. Cost plus.

1. Cost plus is defined to be the sum of the amounts allowable under following subparagraphs (a), (b) and (c).

a. Reimbursement for expenditures made by the Contractor directly attributable to the performance of the extra work, including additional premiums on Faithful Performance and Labor and Materialmen's Bonds, Workers Compensation and Indemnity Insurance and Social Security.

b. A reasonable allowance for the use of shop and field equipment furnished by the Contractor, in conformity with the prevailing rate charged by local Contractors for similar equipment, but in no case will any allowance be made for office expense, general superintendence or other general expenses except as provided in the following subparagraph (c).

c. An allowance of fifteen (15) percent of the sums allowable under the foregoing subparagraphs (a) and (b) for profit, superintendence and general expenses except

that this percentage shall not be allowed on payments to Subcontractor for work of a character normally done by the Contractor.

2. The amount but not the price of all changes or extra work performed shall be entered upon report sheets, furnished by the Engineer, and signed by both parties, which daily reports shall thereafter be considered the true record of extra work done.

3. All claims of the Contractor for compensation for changes or extra work shall be made in the form of itemized invoices and shall be presented together with the data set forth below within thirty (30) days after the close of the calendar month during which the extra work or material covered by such claim is alleged to have been furnished.

The Contractor shall permit an examination by the Auditor of the City of Cottage Grove of all accounts bills and vouchers relating to the extra work and claims shall be paid in the course of business only to the extent that expenditures are provable by the Contractor.

4. The Contractor shall furnish the following data in support of cost plus invoices.

a. Labor: Labor charges must be supported by a certified copy of the Contractor's payrolls, showing: employee's name, employee's labor classification, hours worked each day, total hours worked during the pay period, hourly rate, gross earnings and fringe benefits and taxes.

b. Materials: Material charges must be supported by suppliers' original invoices marked "paid" with the suppliers' name, per the name or initials of the individual receipting the invoice.

Cash and trade discounts allowed by the supplier must be deducted from the invoice amount.

Invoice in turn must be supported by original delivery tickets showing receipt of materials and signatures of Contractor's representative.

In the case of materials withdrawn from the Contractor's own stock, a typed list of such materials must be presented on the Contractor's billhead or letter head showing: quantities, unit (each, pound, dozen, etc.), description of articles, unit cost (including applicable sales taxes), and amount.

All charges for such materials shall be supported by Contractor's receipted delivery tickets approved by the Engineer.

c. Equipment. All equipment charges shall be made in accordance with prevailing "bare" rates.

All equipment charges used in the performance of the work must be itemized to show type of equipment, capacity (for trucks, compressors, etc.), operating time, rate and amounts.

d. Small Tools: The City will not pay for the cost of small tools used in the work but shall make a reasonable allowance for the use of such tools. Claims for this allowance must be approved by the Engineer.

e. Insurance: Charges for workers compensation and other insurance must be supported by a breakdown showing the rate for each type of insurance. Social

Security taxes must not be charged where an employee's earnings have exceeded the taxable maximum.

E. Authorization by City:

1. Except as hereafter provided, all change orders or orders for extra work must be authorized by the City and executed by the City Manager or his representative.

2. Provided, however, Engineer, with approval of the City Manager shall be authorized to execute a change order or order for extra work without the necessity of obtaining a resolution of the City Council in the following case:

a. Where the individual change or extra work does not exceed a cost of fifty thousand dollars (\$50,000); and,

b. Provided that the aggregate of individual changes or extra work so authorized for the contract shall not exceed a total of fifteen (15) percent of the amount of the contract.

F. Payment for changes and extra work shall be made at the time and in the manner provided for payment of the contract work in general, unless otherwise authorized by the City Council.

G. Changes and extra work may be made by the City without notice to the Contractor's sureties, and shall not relieve the sureties of any obligation under their bonds.

It shall be the responsibility of the Contractor before proceeding with any change to satisfy himself that the change has been properly authorized on behalf of the City.

No charge for extra work or any other change in the contract will be allowed unless the extra work or change has been authorized in writing by the City, and the compensation or method thereof is stated in such written authority.

G-22 NOTICE OF POTENTIAL CLAIM

The Contractor shall not be entitled to any additional compensation otherwise payable or contract time extension for any act or failure to act by the City, the happening of any event or occurrence, or any other cause, unless Contractor shall have given the Engineer a written notice of potential claim.

The written notice of potential claim shall set forth the reasons for which the Contractor believes additional compensation will or may be due, the nature of the costs involved and, insofar as possible, the amount of the potential claim. If based on an act or failure to act by the Engineer or the City, except in case of emergency, such notice shall be given to the Engineer prior to the time that the Contractor has started performance of the work giving rise to the potential claim for additional compensation.

In all other cases, notice shall be given within ten (10) days after the happening of the event or occurrence giving rise to the potential claim; if the Contractor intends to assert a claim for an equitable adjustment under this clause, he must, within thirty (30) days after such aforesaid event or occurrence, submit to the City a written statement setting forth the general nature and monetary extent of such claim. No claim shall be considered beyond these time requirements unless this period is extended by the City.

No claim by the Contractor for an equitable adjustment hereunder shall be allowed if asserted after acceptance of final payment under this contract.

It is the intention of this section that differences between the parties arising under and by virtue of the contract shall be brought to the attention of the Engineer at the earliest possible time in order that such matters may be settled, if possible, or other appropriate action promptly taken.

#### **G-23 CITY'S RIGHT TO WITHHOLD CERTAIN AMOUNTS**

The City may withhold from payments to the Contractor, in addition to retained percentage, such an amount or amounts as may be necessary to cover:

- A. Payments that may be earned or due for just claims for labor or materials furnished in and about the work;
- B. Defective work not remedied;
- C. Failure of the Contractor to make proper payments to a Subcontractor;
- D. Reasonable doubt that this contract can be completed for the balance then unpaid;
- E. Damage to another Contractor, where there is evidence thereof.

The City will disburse and shall have the right to act as agent for the Contractor in disbursing such funds as have been withheld pursuant to this paragraph to the party or parties who are entitled to payment there from. The City will render to the Contractor a proper accounting of all such funds disbursed on behalf of the Contractor. Nothing contained herein shall give or bestow any rights on any persons who are not signatory to that contract.

#### **G-24 ACCEPTANCE OF WORK AND FINAL PAYMENT**

The acceptance of the work on behalf of the City shall be made by the City Engineer.

Such acceptance shall not constitute a waiver of guarantee by the City. Within 30 days of acceptance by the City Engineer, there shall be paid to the Contractor a sum equal to 100 percent of the contract price less the aggregate of previous payments.

The acceptance by the Contractor of final payment shall be and shall operate as a release to the City of all claims and all liability to the Contractor other than claims in stated amounts as may be specifically excepted by the Contractor for all things done or furnished in connection with this work and for every act and neglect of the City and others relating to or arising out of this work. Any payment, however, final or otherwise, shall not release the Contractor or its sureties from any obligations under the contract documents or the performance and payment bonds.

Payment at the contract price shall include full compensation to the Contractor for all labor, materials (except as otherwise expressly provided herein), equipment use and expense required for or incidental to the completion of the work in accordance with the drawings and specifications and to the satisfaction of the Engineer.

In case of suspension of the contract, any unpaid balance shall be and become the sole and absolute property of the City of Cottage Grove to the extent necessary to repay to the City any excess in the cost of the work above the contract price.

#### G-25 NO WAIVER OF LEGAL RIGHTS

Should an error be discovered in or payment of unauthorized work be made by the final estimate or should dishonesty on the part of the Contractor be discovered in the work, the City reserves the right, after the final payment has been made, to claim and recover the overpayment, or to make good the defects in the work resulting from the Contractor's dishonesty.

#### G-26 FINAL GUARANTY

All infrastructure, surfacing materials, traffic markings and adjustment to manholes and gate valves work shall be and is guaranteed by the Contractor for a period of one year from and after the date of conditional acceptance of all work by the City.

If, within said guaranty period, repairs or changes are required in connection with guaranteed work, which in the opinion of the Engineer, is rendered necessary as the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the contract, the Contractor shall promptly upon receipt of notice from the City, and without expense to the City: (a) place in satisfactory condition in every particular all of such guaranteed work, correct all defects there; and (b) make good all damage to the building or site, or equipment or contents thereof, which in the opinion of the Engineer, is the result of the use of materials, equipment or workmanship which are inferior, defective, or not in accordance with the terms of the contract; and, (c) make good any work or material, or the equipment and contents of building, structure or site disturbed in fulfilling any such guaranty.

If the Contractor, after notice, fails within ten (10) days to proceed to comply with the terms of this guaranty, the City may have the defects corrected, and the Contractor and his surety shall be liable for all expense incurred, provided, however, that in case of an emergency where in the opinion of the Engineer, delay would cause serious loss or damage, repairs may be made without notice being given to the Contractor and the Contractor shall pay the costs thereof.

#### G-27 CERTIFICATE OF INSURANCE

The Contractor shall furnish the Certificate of Insurance in the amount hereinafter specified for public liability and property damage. The City of Cottage Grove, its employees and designated representatives shall be named as the insured on the certification.

#### G-28 EXCAVATION, TRENCHING AND SHORING

All excavation, trenching and shoring shall comply with Oregon Occupational Safety and Health Code Division 83, Construction (Oregon Administrative Rules, Chapter 437).

The Contractor shall comply with the Specific Trenching Requirements, Sec. 437-83-3539 through 437-83-3593. For all excavations in excess of five (5) feet in depth, the Contractor shall designate in writing the specific means of protection to be used; or, may submit alternative means which have been designed and certified by a registered civil engineer in the State of Oregon for the review and approval of the City Engineer.

The Contractor shall certify in a written form acceptable to the City his/her knowledge of and compliance with all such O.S.H.A. safety requirements.



Nothing herein contained shall be construed to relieve the Contractor in any way from his/her full responsibility for all construction operations, the safety of the workers and public, nor the full compliance with any and all applicable safety regulations and statutes.

All costs related to the required safety compliance and shoring, etc. shall be included in the various bid items and no compensation shall be made therefore.

#### G-29 STORAGE AREAS AND RESTORATION

If the Contractor elects to make arrangements for storage areas, he shall furnish copies of written approval by the property owner(s) to the Engineer. All related restoration work shall be performed in a workmanlike manner at the Contractor's expense.

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**TECHNICAL SPECIFICATIONS  
SECONDARY CLARIFIER 1 REHABILITATION**



**SECTION 01112**  
**SITE CONDITIONS**

**PART 1 - GENERAL**

**1.01 RELATIONSHIP WITH EXISTING FACILITIES**

- A. The City of Cottage Grove owns and operates wastewater facilities located on the project site. The Work under this project will interface with these existing facilities.
- B. Owner's personnel will be responsible for operating and maintaining the existing facilities throughout the execution of this Contract.
- C. Take particular care to avoid clutter and debris at the site of the work. This includes work areas and staging areas.
- D. Limit operations, storage of equipment, and materials and parking of employees to the areas designated on the Drawings.
- E. Except for allowable out-of-service periods as specified, the Contractor shall be responsible for maintaining in operation during construction all sanitary and storm sewers, service laterals, catch basins, manholes, and related facilities. Provide all temporary pumps and piping required to keep facilities in operation throughout the construction period. No existing sanitary or storm sewer shall be taken out of service without the written permission of the Engineer.

**1.02 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTIES AND SERVICE**

- A. Oregon law requires the Contractor to follow rules adopted by the Oregon Utility Notification Center. Contractor shall comply with such requirements as set forth in the Oregon Administrative Rules, Chapter 952, Division 1, Utility Notification Center. Copies of these rules may be obtained by calling the Center at (503) 232 1987 or at:  
<https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=4223>
- B. Notify owners of existing utilities prior to the performance of work in the vicinity of their facilities. Provide notification at least two business days in advance of excavation, the date and location of the excavation to be undertaken.
- C. Do not begin excavation until receiving a written notification from operators of underground facilities and utility operators that they have:
  - 1. Marked the locatable underground utilities; or
  - 2. Provided a description of underground utilities in the area of the proposed excavation that cannot be located; or
  - 3. Provided notification that no utilities exist within the area of the proposed excavation.
- D. Once underground utilities have been marked, maintain marks during the course of the work.
- E. Where the Contractor's operations could cause damage or inconvenience to existing telephone, power, oil, gas, water, sewer, or irrigation systems, make arrangements necessary for the protection and sustained operation of these utilities and services. If

temporary disruption is necessary to complete the work, make arrangements with the owner of the utility prior to service cutoff and also notify the Engineer.

- F. The Contractor is solely and directly responsible to the Owners of utilities, property, fences, and other existing appurtenances for any damage, injury, expense, loss, inconvenience, delay, suits, actions, or claims of any character brought because of any injuries or damage that may result from the construction operations under this Contract.
- G. Neither the Owner nor its officers or agents shall be responsible to the Contractor or the Contractor's subcontractors for damages as a result of the Contractor's failure to protect utilities encountered in the work.
- H. Replace, at Contractors expense, any and all existing utilities or structures damaged during construction, unless otherwise provided for in these Contract Documents.

#### 1.03 EXISTING UTILITIES

- A. Existing utilities are shown on the drawings. The type, location, size and depth of existing underground utilities shown on the Drawings were obtained from sources of varying reliability. Efforts have been made to locate and delineate all known underground facilities; however, the Engineer cannot assume responsibility for the completeness and/or accuracy of the delineation of underground facilities whether shown on the Drawings or not, nor for the existence of other buried objects and/or facilities which may be encountered but are not shown on the Drawings.
- B. Connecting to Existing Facilities: Expose all underground facilities that are to be connected to or that might be affected by the construction of the proposed improvements for verification of location and elevation prior to ordering pipe.

#### 1.04 FIELD RELOCATION

- A. During the progress of construction, minor relocations of the work may be necessary. If field conditions are encountered that will prevent construction as shown, notify the Engineer before continuing with the work. The Engineer may make minor field revisions as necessary to resolve the field condition without change in the Contract Price. If the Contractor fails to notify the Engineer when such field conditions are encountered, and proceeds with the work despite the interference, it shall be at the Contractor's own risk.

### **PART 2 - NOT USED**

### **PART 3 - NOT USED**

### **END OF SECTION**

## **SECTION 01140**

### **WORK SEQUENCE AND CONSTRAINTS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Schedule requirements, construction constraints, and a suggested Work sequence for specific elements of the Project.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is reference in this Section
  - 1. Section 01999 – Reference Forms

##### **1.03 GENERAL SEQUENCING REQUIREMENTS**

- A. The sequencing requirements and construction constraints described are critical elements of the Work and are presented to underscore the importance of proper management, planning, scheduling, coordination, and execution of the Work.
- B. Sequencing requirements and construction constraints have been defined in this Section for only certain structures, facilities, and elements of the Work. All work, whether or not addressed in this Section, shall be governed by applicable specified requirements. If additional shutdown constraints are necessary to allow implementation of Contractor's construction procedures and schedule, the Engineer will establish such constraints.
- C. Contractor's Construction Schedule:
  - 1. Clearly illustrate the proposed sequence of construction.
  - 2. Conform to the sequencing requirements and limitations specified in this Section.
  - 3. Modify or adapt the suggested sequencing as necessary to complete the project provided all environmental and service continuity requirements are met.

##### **1.04 OPERATIONAL CONTINUITY**

- A. The City of Cottage Grove owns and operates wastewater treatment facilities. The Work under this project will interface with these existing facilities.
- B. The existing wastewater collection system and treatment plant continuously receives, conveys and treats wastewater. Do not interrupt functions necessary to maintain operation of these facilities except as approved by the Engineer through review of the Contractor's Facility Outage Plan and as specified herein.
- C. Coordinate the Work to minimize interference and interruption of the normal operation of the Owner's existing facilities through proper planning and by making temporary connections.
- D. Except for allowable out-of-service periods as specified, maintain operation of sanitary and storm sewers, service laterals, catch basins, manholes, and similar facilities.

1. Provide temporary pumps, piping, power, bulkheads, plugs, and other devices that are required to keep such facilities in operation when these must be temporarily taken out of service in order to conduct the Work.
2. Notify the Engineer in writing 3 days in advance of the time it is necessary to take utilities out of service.
3. Notify public agencies and utility companies when service to customers will be temporarily interrupted to perform the Work and coordinate shutdowns with these agencies.

#### 1.05 PERMIT VIOLATIONS

- A. The wastewater treatment facilities must continuously comply with the Owner's National Pollutant Discharge Elimination System (NPDES) permit.
- B. Construction of the Work under this Contract must be undertaken in compliance with the terms and conditions of various permits that the Owner has obtained for this project.
- C. In the event NPDES permit violations or spills are caused or, in the Owner's opinion, will be caused by the Contractor's operations, the Owner shall be entitled to immediately employ others to stop the violations or potential spills without giving written notice to the Contractor. All costs incurred by the Owner to stop or prevent permit violations shall be paid by the Contractor.
- D. Under no circumstances shall wastewater be discharged, bypassed or spilled to creeks, drainage ditches, or other waterways; storm drain systems; or the ground surface. In the event accidental discharge or bypassing is caused by the Contractor's operations, the Owner shall immediately be entitled to employ others to stop the bypassing without giving written notice to the Contractor. All costs incurred by the Owner to stop or prevent the bypass shall be paid by the Contractor.
- E. Penalties imposed on and costs incurred by the Owner as a result of violations caused by the actions of the Contractor, his employees, or subcontractors, shall be borne in full by the Contractor, including legal fees and other expenses to the Owner resulting directly or indirectly from Contractor's actions.
  1. Under the terms of the NPDES permit issued to the Owner, the Owner is liable for the following penalties:

NPDES Permit

\$10,000 per day for each violation

#### 1.06 ACCESS

- A. The existing facility where Contractor's work is to be done will be occupied by the Owner throughout the construction period. Access to the site by the Owner's personnel is required for daily operations, maintenance, and administration. Additionally, regular traffic into and out of the site is to be expected.
- B. Contractor shall provide all necessary access to the Owner's personnel as required to safely and efficiently operate/maintain the facilities. At all times during the Contract duration, the Contractor is to provide the Owner's personnel and representatives safe and immediate access to all process control equipment.
- C. Contractor shall provide for unimpeded access for all delivery vehicles transporting materials, chemicals and equipment to the facility for the Owner's operations. Contractor



shall coordinate the work to avoid interference with vehicular access to the existing plant site and normal operation of plant equipment and processes.

1.07 NOT USED

1.08 FACILITY OUTAGE PLAN

- A. Prepare and submit a detailed Facility Outage Plan when removal of an existing facility from service is necessary to complete the Work.
- B. Submit the Facility Outage Plan to the Engineer for review and approval at least 2 weeks prior to the scheduled outage. Develop the Facility Outage Plan to satisfy the Work Sequence restrictions and conditions specified in this Section. Do not proceed with any Work involving facility outages until the Outage Plan has been approved by the Engineer.
- C. The Facility Outage Plan shall describe, as applicable, a listing of existing facilities that will be taken out of service, methods for preventing bypassing of other treatment units, the length of time required to complete the operation, and the necessary personnel and equipment which will be provided in order to successfully complete the operation.
- D. A System Outage Request (SOR) form shall accompany each outage or bypass plan (See Section 01999). Coordinate the outage schedule with the overall construction schedule.

1.09 REMOVING EXISTING FACILITIES FROM SERVICE

- A. Existing systems or individual equipment items shall be isolated, decommissioned, de-energized, or depressurized only by the Owner's operations personnel. This work will be done in accordance with the Facility Outage Plan and schedule prepared by the Contractor.
- B. The Contractor shall design and provide all necessary bulkheads, cofferdams, and support structures to allow isolation of work areas from tanks, pipes, and/or channels that are in service. Bulkheads, cofferdams, and support structures shall conform to applicable OSHA requirements.
- C. The Contractor shall provide all necessary temporary pumps, piping, power, electrical wiring, controls, and labor during and subsequent to all shutdown activities as required. Maintain adequate access to the plant facilities, utilities, and equipment during construction to allow continued operation and maintenance by Owner's personnel to take place.
- D. Prior to any shutdown or flow diversion, all materials, bypass pumps, fittings, supports, equipment and tools shall be on the site and all necessary skilled labor scheduled prior to starting any connection work.
- E. If valves or gates need to be opened or closed, or mechanical equipment turned off or turned on, or similar operations performed to allow construction to proceed, this is to be performed by the Owner's operations staff working in coordination with Contractor personnel. Valves and gates that may be used to isolate lines and facilities may not completely seal. Contractor shall allow for leakage in planning the Work. Contractor shall clean the work areas as required to perform the work.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 WORK COORDINATION**

- A. Schedule and coordinate the overall Work and construction operations, including the work of subcontractors and the timely provision of products and supplies.
- B. Perform Work in an orderly and logical sequence. Individual specification Sections may identify specific requirements that are related to Work sequence. These types of constraints are not repeated in this Section but shall be followed by the Contractor.

### **3.02 WORK CONSTRAINTS**

- A. Work Hours
  - 1. Except as otherwise required for the safety or protection of persons and except as otherwise stated in the Contract Documents, Work may only be performed Monday through Friday during the hours of 7:00 am and 6:00 pm. Contractor will not perform Work on a Sunday or any legal holiday defined by the City of Cottage without written consent from the Owner.
  - 2. Legal holidays are defined as:
    - a. New Year's Day on January 1.
    - b. Memorial Day on the last Monday in May.
    - c. Independence Day on July 4.
    - d. Labor Day on the first Monday in September.
    - e. Thanksgiving Day on the fourth Thursday in November.
    - f. Christmas Day on December 25.
    - g. When a holiday falls on Sunday, the following Monday is recognized as the legal holiday. When a holiday falls on a Saturday, the preceding Friday is recognized as the legal holiday.
- B. Contractor shall undertake the Work in compliance with the constraints defined in the following paragraphs:
  - 1. Secondary Clarifier 1 will be available for the Contractor to begin work within the secondary clarifier on July 1, 2023 and must be in operation by October 15, 2023.
  - 2. The City will operate the dewatering well shown on the drawings but the Contractor will need to provide additional dewatering as necessary.

## **END OF SECTION**

## SECTION 01200

### MEASUREMENT AND PAYMENT

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Methods of measurement and payment for specific items of Work under this Contract. Refer also to General Conditions for administrative aspects of payments by the Owner to the Contractor.

##### 1.02 BID COMPONENTS AND PAYMENT

- A. The Bid Form is comprised of the following components:
  - 1. Lump Sum Work
  - 2. Allowances (Not Used)
  - 3. Unit Price Work
- B. Contractor's cost for "Lump Sum Work" shall cover all Work indicated by the Contract Documents with the exception of cash allowances and specific items of work that are to be paid on a Unit Price basis as indicated on the Bid Form. Lump Sum Work will be paid for on a progress payment basis in accordance with the provisions of the General Conditions.
- C. "Allowances" are not used on this project.
- D. "Unit Price Work" is Work indicated on the Drawings or specified. The price of each unit of Work is to be defined by the Bidder in the Unit Price Bid Schedule in the Bid Form and shall include all materials, labor, equipment, and incidentals required to complete each Work Item. When actual Work differs from the basis of the Work Item, costs shall be adjusted on a pro-rata basis or other method suited for the particular condition. Work Items established for this Work have been identified on the Bid Form and are described as follows:
  - 1. **Bid Item No. 1: Mobilization and Demobilization is a General Lump Sum Item.**
    - a. The Work of this Bid Item includes but is not necessarily limited to mobilizing and demobilizing equipment and labor for the Work described in the Bid Items below.
    - b. The Work of this bid item includes but is not limited to full compensation for furnishing all labor, materials, tools, equipment, and other incidentals necessary to mobilize/demobilize the necessary forces to complete the project within the time specified in these specifications.
    - c. This Bid Item also includes payment for obtaining all bonds, all Contractor acquired permits, licenses, agreements, certifications, notices of intent, moving onto the site of all equipment, materials and staff including obtaining and set up of Contractor's staging area/yard, and furnishing and erecting all needed construction facilities.

2. **Bid Item No. 2: Preform all General Conditions Work is a General Lump Sum Item.**
  - a. The Work of this Bid Item includes but is not necessarily limited to providing and executing all health, safety, security, and environmental plans, providing all site general conditions facilities, and performing all other general conditions Work shown on the Plans or specified herein other than Work separately provided for under other Bid Items. The Work of this Bid Item includes project management, drafting, submitting and revising submittals, location and protection of existing utilities, fencing and barricades, traffic control, survey, construction lighting if required, project signage, project security, preparation of progress schedules and reports, attendance at contract meetings, coordination with 3rd party utility owners, and preparation of record drawings.
3. **Bid Item No. 3: Demolition of Handrailing around the Secondary Clarifier is a Unit Price Item per Linear Foot (LF).**
  - a. The Work of this Bid Item includes all labor, materials, and equipment required for demolition and off-site disposal of the existing handrailing around the Secondary Clarifier.
  - b. The Work also includes but is not necessarily limited to sawcutting, concrete demolition, breaking/chipping of concrete around handrail anchors, excavation, loading, hauling of excess soils to stockpile, backfill, compaction, and surface restoration around each handrail location.
4. **Bid Item No. 4: Furnish and Install Handrail around Secondary Clarifier is a Unit Price Item per Linear Foot (LF).**
  - a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required to install a new handrail around the Secondary Clarifier.
  - b. The Work also includes but is not necessarily limited to layout, anchoring, welding, concrete repour around handrail locations, and surface restoration around each handrail location.
5. **Bid Item No. 5: Demolition of Sidewalk is a Unit Price Item per Cubic Yard (CY).**
  - a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required to complete all required demolition and debris disposal for the sidewalk.
  - b. The Work also includes but is not necessarily limited to breaking/chipping existing concrete slabs of the sidewalk, disposal of concrete, and surface restoration and repair of modified permanent sidewalk per contract documents.
6. **Bid Item No. 6: Demolition of Center Column Foundation is a Unit Price Item per Cubic Yard (CY).**
  - a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required to complete all required demolition and debris disposal for the foundation.
  - b. The Work also includes but is not necessarily limited to breaking/chipping existing concrete slabs of the foundation, disposal of concrete, shoring,

excavation, loading and hauling debris and soil to stockpile location, sheeting and shoring, dewatering, backfill, surface restoration and repair of structures affected by foundation demolition per contract documents.

**7. Bid Item No. 7: Concrete Work is a Unit Price Item per Cubic Yard (CY).**

- a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required to complete all required installation of concrete structures such as the Secondary Clarifier foundation, new stairs, sidewalk, and concrete footing.
- b. The Work also includes but is not necessarily limited to design, engineering, layout, excavation, hauling soil to stockpile, shoring, concrete slab, rebar, frame, cover, aggregate base, compaction, backfill, material testing, surface restoration and repair of modified permanent structures per contract documents.

**8. Bid Item No. 8: Sandblast Wall and Trough Repairs is a Unit Price Item per Square Foot (SF).**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to sandblast the Secondary Clarifier Walls.

**9. Bid Item No. 9: Pressure Injection for Wall Repairs is a Unit Price Item per Liner Feet (LF).**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required for pressure injection in 30 locations along the secondary clarifier wall per the contract drawings.

**10. Bid Item No. 10: Removal of 2" Grout from the Existing Slab is a Unit Price Item per Square Foot (SF).**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to remove the 2" grout from the existing Secondary Clarifier slab.

**11. Bid Item No. 11: Furnish and Install 2" Fiberglass Reinforced Grout and Bonding Adhesive to Existing Slab is a Unit Price Item per Square Foot (SF).**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to install the 2" fiberglass reinforced grout & bonding adhesive to the existing Secondary Clarifier slab.

**12. Bid Item No. 12: Repair Existing Wall, Weir, and Trough is a Unit Price Item per Square Foot (SF).**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to repair existing Secondary Clarifier wall, weir, and mortar on trough with cementitious coating.

**13. Bid Item No. 13: Demolition and Replacement of Floor Relief Valves is a Unit Price Item per Each (EA).**

- a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required for demolition and debris disposal for the floor relief valves including sawcutting and demolition of approximately a 4-foot

square opening in the Secondary Clarifier floor. The Work of this Bid Item also includes furnishing all labor, materials, and equipment required the replacement and installation of new floor relief valves.

**14. Bid Item No. 14: Furnish and Install New Floor Relief Valves is a Unit Price Item per Each (EA).**

- a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required for including sawcutting and demolition of approximately a 4-foot square opening in the Secondary Clarifier floor for each valve location and the installation of new floor relief valves.

**15. Bid Item No. 15: Demolition of 12” RAS piping is a Unit Price Item per Square Foot (SF).**

- a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required for demolition and debris disposal of the 12” RAS pipe.
- b. The Work also includes but is not necessarily limited to sawcutting, concrete demolition, breaking/chipping, excavation, loading, hauling of excess materials to stockpile, surface restoration around the pipe location, removal of 12” pipe per contract documents.

**16. Bid Item No. 16: Furnish and Install 12” RAS piping is a Unit Price Item per Linear Foot (LF).**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required for installation of new 12” RAS pipe.

**17. Bid Item No. 17: Demolition of 24” RCP ML Piping is a Unit Price Item per Linear Foot (LF).**

- a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required for demolition and debris disposal of the 24” RCP ML pipe.
- b. The Work also includes but is not necessarily limited to sawcutting, concrete demolition, breaking/chipping, excavation, loading, hauling of excess materials to stockpile, surface restoration around the pipe location, removal of 24” pipe per contract documents.

**18. Bid Item No. 18: Furnish and Install 24” RCP ML Piping is a Unit Price Item per Linear Foot (LF).**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required for installation of new 24” RCP ML pipe.

**19. Bid Item No. 19: Complete All Required Demolition of Secondary Clarifier Mechanism is a General Lump Sum Item.**

- a. The Work of this Bid Item includes furnishing all labor, materials, and equipment all required demolition and debris disposal of Secondary Clarifier Mechanism including but not limited to sludge and scum collection equipment, scum troughs, scum baffles, weir plates, drive equipment, bridge, and walkway for access to the drive equipment, and miscellaneous appurtenances.

- 20. Bid Item No. 20: Assemble and Install All Required of Secondary Clarifier Mechanism is a General Lump Sum Item.**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and all equipment required for assembling and installation of the new pre-purchased Secondary Clarifier Mechanism including but not limited to sludge and scum collection equipment, scum troughs, scum baffles, weir plates, drive equipment, bridge, and walkway for access to the drive equipment, and miscellaneous appurtenances.
- 21. Bid Item No. 21: Trough Joint Repairs is a Unit Price Item per Each (EA).**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to repair the trough joints.
- 22. Bid Item No. 22: Demolition of 1” HCS Piping is a Unit Price Item per Linear Foot (LF).**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required for demolition and debris disposal of the 1” HCS pipe around the scum baffle.
- 23. Bid Item No. 23: Furnish and Install 1” HCS Piping, Diaphragm Valve, & Pipe Supports is a Unit Price Item per Linear Foot (LF).**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required for installation of replacement 1” HCS pipe, diaphragm valve, and pipe supports around the scum baffle.
- 24. Bid Item No. 24: Removal and Reattachment of the Stamford Baffle is a General Lump Sum Item.**
- a. The Work of this Bid Item includes furnishing all labor, materials, and equipment required to remove the Stamford Baffle and then reattach the Stamford Baffle per construction documents.
- b. The Work also includes but is not limited to removal, storage and protection, cleaning, structural repairs where needed, installation of baffle per construction documents.
- 25. Bid Item No. 25: Demolition of Existing 1” 3W Piping, Valves, and Insulation is a General Lump Sum Item.**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required for demolition of the existing 1” 3W piping, valves, and the insulation.
- 26. Bid Item No. 26: Furnish and Install Replacement 1” 3W Piping, Valves, and Insulation is a General Lump Sum Item.**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to install replacement 1” 3W piping, valves, and the insulation.
- 27. Bid Item No. 27: Demolition of Existing 3/4” Alum Piping, Valves, and Insulation is a General Lump Sum Item.**

- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required for demolition of the existing 3/4" alum piping, valves, and the insulation.
- 28. Bid Item No. 28: Furnish and Install Replacement 3/4" Alum Piping, Valves, and Insulation is a General Lump Sum Item.**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to install replacement 3/4" alum piping, valves, and the insulation.
- 29. Bid Item No. 29: Start-up, Testing, Training, and Commissioning at the Secondary Clarifier is a General Lump Sum Item.**
- a. The Work of this Bid Item includes but is not necessarily limited to furnishing all labor, materials, and equipment required to completely coordinate and perform the start-up, testing, and training of Operations staff for the maintenance and operation of the Secondary Clarifier per contract documents.

### 1.03 SCHEDULE OF VALUES

- A. Format: Identify each line item in the Schedule of Values with number and title of the major Specification sections. Submit typed schedule on 8½ x 11-inch paper; Contractor's standard form or media-driven printout will be considered on request.
- B. At the pre-construction meeting, submit a preliminary Schedule of Values to the Owner's Representative for review. The Contractor shall incorporate any review comments from the Owner's Representative, and submit a final Schedule of Values at least 21 days prior to submitting the first Application for Payment.
- C. The Schedule of Values shall assign a fair, reasonable and equitable dollar value for each activity on the Contractor's construction schedule. The Schedule of Values shall include anticipated progress payments for each item in the bid schedule through the final payment. In addition, a detailed breakdown of lump sum prices shall be included in the Schedule of Values.
- D. The Schedule of Values shall specifically indicate installed cost for materials and equipment for each bid and sub-bid item.
- E. Each activity's assigned value shall consist of labor, equipment and materials cost and a prorata contribution to overhead and profit. Breakdown shall be so organized as to facilitate assessment of work and payment of subcontractors.
- F. The sum of the assigned values shall equal the lump sum price of the activity.
- G. If, in the opinion of the Owner's Representative or Owner, the Schedule of Values is not balanced, the Contractor shall provide documentation substantiating the cost allocations of those activities believed to be unbalanced. Cost allocation will be considered unbalanced if an activity on the construction schedule has been assigned a disproportionate allocation of labor, direct, or overhead and profit costs which result in progress payment request(s) which would create a condition where insufficient funds are available to complete the unfinished work. Upon request by Owner, support values shall be given with data that will substantiate their accuracy. Upon Owner's request, the Contractor shall submit additional detailed cost information.
- H. Upon acceptance of the Schedule of Values, it shall be used as a basis for processing all progress payment requests.



#### 1.04 PROGRESS PAYMENT REQUESTS

- A. Submit Progress Payment Requests during the course of the project in conformance with the General Condition.
- B. Submittal of progress record drawings of the project will be required at 25%, 50%, 75%, and substantial completion of the project. These submittals shall accompany the progress payment request and will be a condition of processing payment requests.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

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**SECTION 01310**  
**PROJECT MEETINGS**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Requirements for calling for and conducting meetings for the Work.

1.02 REFERENCED SECTIONS

- A. The following Section is referenced in this Section
  - 1. Section 01320 – Construction Schedule

1.03 GENERAL

- A. Project meetings and conferences are an important administration and communication requirement of all project participants. Meetings will be conducted throughout the course of the construction to address issues related to the Work, review and coordinate progress of the Work, and to discuss other matters of common interest to project participants.
- B. Meeting and conference locations and qualified participants will be determined by the Engineer and the Contractor based on the meeting agenda topics.

1.04 PRECONSTRUCTION CONFERENCE

- A. Prior to the start of construction, the Engineer will schedule a meeting of the Contractor, Owner, and their respective representatives. The general purpose of the meeting will be to establish working relationships, begin coordination of construction matters, discuss the Work, and to review the pertinent features of the Contract. The duration of the preconstruction conference will take approximately 4 hours.
- B. The agenda for the meeting will cover at least the following items, a more detailed agenda will be distributed at the meeting:
  - 1. Organization of the Contractor's forces and personnel, including subcontractors and materials suppliers.
  - 2. Lines of authority and channels and procedures for communication.
  - 3. Contractor's construction schedule, including sequence of critical work.
  - 4. Processing of shop drawings and other data that will be submitted to Owner for review.
  - 5. Processing of change order requests and monthly applications for payment.
  - 6. Procedures for quality control, housekeeping and related matters.
- C. Contractor should be prepared to discuss the following topics:
  - 1. Preliminary construction schedule and critical path.
  - 2. Schedule of submittals and submittals needing short turn-around times.
  - 3. Schedule of Values for construction payments.
  - 4. Critical work sequencing.

5. Plans for mobilization, arrangement and use of staging and storage areas, use of site, location and arrangement of field offices, and site security.
- D. Minutes of Meeting
1. The Engineer will compile minutes of the meeting and distribute copies to all participants.

#### 1.05 PROGRESS MEETINGS

- A. Unless otherwise arranged, there will be a weekly progress meeting at a time and at an on-site location that is mutually agreed upon between the Contractor, Engineer and Owner.
1. Meetings are to enable orderly project review during the progress of work.
  2. Engineer, Owner, Contractor's Superintendent, representatives of subcontractors, suppliers' representatives as may be needed, other Contractors working at the site, and other parties shall attend these meetings.
  3. Engineer will preside over the meeting and will compile and distribute minutes of the meeting.
- B. The purpose of the weekly meetings is to coordinate the efforts of all concerned to result in smooth and coordinated progress towards completion of the overall project.
- C. Contractor shall bring to each weekly meeting the updated 3-week "look ahead" schedule.
- D. The Contractor will be required to address the following items at the weekly meeting:
1. Work completed last week.
  2. Work anticipated next week.
  3. Log of submittals and Requests for Information.
  4. Contract document deficiencies or questions noted during prior week.
  5. Schedule status and corrective measures and procedures that are planned to place the project back on schedule, if such action is necessary.
  6. Report of any accidents, and any site safety issues that need to be addressed.
- E. Other agenda items to be discussed include:
1. Review and revise as necessary and approve minutes of previous meetings.
  2. Status of Requests for Information, Change Order Requests, submittals and shop drawings.
  3. Identify problems that impede planned progress.
  4. Other current business pertaining to the Work.
- F. Revision of Minutes
1. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting, they will be accepted as properly stating the activities and decisions of the meeting.
  2. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.

3. Challenge to minutes shall be settled as priority item of "old business" at the next regularly scheduled meeting.

#### 1.06 PROGRESS SCHEDULE AND PROGRESS BILLING MEETINGS

- A. Once each month, a progress schedule and progress payment meeting will be conducted with the Engineer. The purpose of this meeting is to review the Progress Payment Estimate and reach agreement on the extent of the Work completed during the pay period.
- B. The meeting date will be scheduled in accordance with the Owner's deadline for submittal of Progress Pay Estimate.
- C. The updated progress schedule will also be reviewed at this meeting as described in Section 01320. Schedule impacts, time extension requests, actual and anticipated schedule activity sequence/duration changes, delays, and other schedule-related topics will be discussed.
- D. The Engineer may require more frequent progress schedule meetings should there be schedule revisions that necessitate such a meeting.

#### 1.07 SUBMITTAL MEETINGS

- A. When required in the individual technical specification, or if requested by the Contractor or the Engineer, a meeting regarding a required submittal will be held to facilitate the timeliness of the submittal preparation and review process.

#### 1.08 QUALITY ASSURANCE MEETINGS

- A. The Contractor or the Engineer may request a meeting prior to the start of a particular phase of the project to discuss how the Work shall be accomplished in accordance with the quality requirements of the Contract Documents, Codes, permits and industry standards. Quality assurance inspections and tests that are applicable to the Work will be discussed.

#### 1.09 PRE-INSTALLATION MEETINGS

- A. When required in the individual specification, or if requested by the Contractor or Engineer, a pre-installation meeting will be held to review conditions of the installation, installation procedures, and coordination with related work. This meeting will be scheduled to take place in advance of installation of the equipment or as required in the technical specifications.

#### 1.10 PRE-SUBSTANTIAL COMPLETION MEETING

- A. Thirty (30) days prior to the estimated substantial completion, the Owner, Engineer, Contractor, and appropriate subcontractors will meet to review maintenance manuals, guarantees, closeout submittals, bonds, and service contracts for materials and equipment.

#### 1.11 SPECIAL MEETINGS

- A. Any time during progress of the Work, the Owner and the Construction Manager shall have the authority to require the Contractor and any subcontractor, suppliers, or service providers to attend job-site conferences on matters which require immediate or special attention. Any notice of such conference shall be duly observed and complied with by the Contractor and subcontractors, suppliers, or service providers without extra cost to Owner.

1.12 POST CONSTRUCTION GUARANTY PERIOD MEETING

- A. Contractor shall meet with a representative of the Owner and the Engineer approximately eleven (11) months after the date of Substantial Completion to inspect the Work. Meeting will be arranged by the Owner at least seven (7) days before meeting. The Contractor will require attendance of its Project Manager/Superintendent, appropriate manufactures and appropriate subcontractors.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## **SECTION 01320**

### **CONSTRUCTION SCHEDULE**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Procedures for preparing and revising the construction schedule used for planning and managing construction activities.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. General Conditions
  - 2. Special Provisions

##### **1.03 COORDINATION WITH GENERAL CONDITIONS**

- A. Prepare and submit a Preliminary Schedule in accordance with the requirements of General Conditions and any Special Provisions.
- B. The Contractor's execution of the Work shall begin based on the Preliminary Schedule accepted by the Engineer. As Work progresses, the Schedule shall be updated and resubmitted in accordance with the requirements of this Section.

##### **1.04 USE OF SCHEDULE**

- A. The schedule and subsequent updates provides a basis for determining the progress status of the project relative to the completion time, specific dates, and for determining the acceptability of the Contractor's progress payment estimates.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION**

##### **3.01 DESCRIPTION**

- A. The Contractor shall prepare a time scale network schedule using a critical path method. A general guide for preparing such a schedule is contained in "The Use of CPM in Construction, a Manual for Contractors," published by the Associated General Contractors of America.
- B. The schedule shall depict all significant construction activities and all items of work listed in the breakdown of contract prices submitted by the Contractor in accordance with Section 00700.
  - 1. Indicate assigned values for each part of the work.
  - 2. Indicate dependencies between activities to establish the effect the progress of any one activity has on the schedule.
- C. Completion time shall be shown on the schedule. Activities making up the critical path shall be identified.

- D. No activity on the schedule shall have a duration longer than 21 days or assigned value greater than \$50,000, except activities comprising only fabrication and delivery, which may extend for more than 21 days.
  - 1. Activities that exceed these limits shall be divided into more detailed components.
  - 2. The scheduled duration of each activity shall be based on the work being performed during the normal 40-hour workweek with allowances made for legal holidays and normal weather conditions.

### 3.02 SUBMITTAL PROCEDURES

- A. Submit Preliminary Schedule in accordance with Section 00700.
- B. Submit the following items:
  - 1. Two copies of the project schedule formatted to fit 11x17 inch sheets.
  - 2. Electronic file of the schedule.
- C. The Engineer will review the Preliminary Schedule to ascertain compliance with specified project constraints, compliance with milestone dates, reasonableness of durations and sequence, accurate inter-relationships and completeness.
- D. Review comments will be transmitted to Contractor following completion of preliminary review.
- E. Revise and resubmit schedule in accordance with written comments, or request joint meeting to resolve objections.
- F. When schedule reflects the Engineer and Contractor's agreement of project approach and sequence, schedule will be accepted as the Base Schedule. Use the accepted Base Schedule for planning, organizing and directing the work and for reporting progress.

### 3.03 UPDATING THE SCHEDULE

- A. Submit an updated schedule with each Application for Payment.
- B. Progress payment requests may not be processed by Engineer if updated schedule has not been submitted or if update is found unacceptable.
- C. Prepare update using most recent accepted version of schedule including:
  - 1. Actual start date of activities that have been started.
  - 2. Actual finish date of activities that have been completed.
  - 3. Percentage of completion of activities that have been started but not finished.
  - 4. Actual dates on which milestones were achieved.
- D. Submit narrative report in conjunction with updated schedule describing:
  - 1. Activities added to or deleted from schedule. Identify added activities in manner distinctly different from original activity designations.
  - 2. Changes in sequence or estimated duration of activities.
  - 3. Current or anticipated problems and delays affecting progress, impact of these problems and delays and measures taken to mitigate impact.



4. Assumptions made and activities affected by incorporating change order work into the schedule.

#### 3.04 REVISIONS TO SCHEDULE

- A. Submit revised schedule within five (5) days when:
  1. Delay in completion of any activity or group of activities indicates an overrun of the contract time or milestone dates by twenty (20) working days or five (5%) percent of the remaining duration, whichever is less.
  2. Delays in submittals, deliveries, or work stoppages are encountered making necessary the replanning or rescheduling of activities.
  3. The schedule does not represent the actual progress of activities.
  4. Any change to the sequence of activities, the completion date for major portions of the work, or when changes occur that affect the critical path.
  5. Contract modification necessitates schedule revision; submit schedule analysis of change order work with cost proposal.
- B. Submit printed copies of the revised schedule and electronic file.
- C. Make revisions on most recently accepted version of schedule.

#### 3.05 THREE WEEK “LOOK AHEAD” SCHEDULE

- A. In addition to the overall Construction Schedule, provide a “Look Ahead” schedule in bar chart format. Show work activities undertaken in the preceding week and the work activities that will be undertaken during the upcoming three weeks.
- B. Prepare the Look Ahead schedule weekly and submit to the Engineer at the weekly construction progress meeting.

### **END OF SECTION**

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**SECTION 01325**  
**FIELD ENGINEERING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Requirements for surveying and surveying record documents.

**1.02 REFERENCED SECTION**

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 01770 – Contract Closeout Procedures
  - 3. Section 01780 – Record Documents

**1.03 DATUM**

- A. Vertical and horizontal datum are based on the coordinates and benchmarks shown on the Drawings.
  - 1. Locate and protect Owner furnished control points prior to starting the Work and preserve control points during construction.
  - 2. Re-establish control points disturbed by operations at no cost to Owner.
  - 3. The elevations of any existing facilities, in particular where tie-ins to this Project are required, must be field verified by the Contractor and confirmed with relation to the elevations for the facilities under this Project.
- B. Establish other vertical and horizontal control from these Owner furnished reference points as required to properly layout and construct the Work. Install connections based on actual elevations of existing structures to which connections are made.
- C. Base layout upon existing structures and the vertical and horizontal datum established by the Owner.
- D. The Contractor shall be responsible for the preservation of existing survey monuments or permanent bench marks. Any monuments or bench marks disturbed or destroyed by Contractor shall be referenced and replaced by a licensed land surveyor.

**1.04 QUALITY ASSURANCE**

- A. The Contractor's Surveyor shall be a land surveyor registered in Oregon or civil engineer qualified and licensed in Oregon with at least five (5) years surveying experience of similar projects.
- B. Dimensions for existing structures, piping, paving, and other nonstructural items are taken from the available information during the Owner's planning and design.
  - 1. Field verify dimensions and conditions in advance of any construction in the area.
  - 2. Any discrepancy between the field survey and the information indicated in the Contract Documents shall be immediately brought to Construction Manager's

attention by written notification.

3. In questions arising as to proper location of lines and grades, the Construction Manager's decision will be final.
- C. Accuracy of the Contractor's stakes, alignments and grades may be periodically and randomly checked by the Construction Manager.
  1. If requested by Construction Manager, the Contractor shall supply field labor as required, at no extra charge to Owner, to aid and assist the Construction Manager in checking location and grades of the work as set by the Contractor.
  2. This shall include postponing parts of the Work affected by survey check, moving materials and equipment that interfere with a clear line of sight between horizontal control points and the construction work.
  3. The Contractor is not to assume that Construction Manager's check substitutes or complements the Contractor's required field quality control procedures.
- D. The Contractor's registered land surveyor shall check the line and grade of the slab or footing concrete forms prior to the first slab or footing pour at each structure and building.

#### 1.05 SUBMITTALS

- A. Comply with Section 01330.
- B. Furnish Construction Manager with one (1) copy of all land surveyor notes, calculations, sketches and drawings within 48 hours after completion of each survey task.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### 3.01 PROJECT SURVEY REQUIREMENTS

- A. As part of the bid price for the construction of the improvements provide and be responsible for the layout of all work specified in the contract.
- B. Provide necessary surveys, field staking, and positioning for the construction of all components at the proper alignment, elevations, grades, and positions, as indicated on the Drawings and as required for the proper operation and function.
- C. Stake the work limits and right-of-way lines prior to the start of sitework.
- D. Lay out work, including structures and pipelines, and be solely responsible for executing the Work in accordance with the lines and grades indicated.

#### 3.02 RECORD DOCUMENTS

- A. Prepare, maintain and submit Record Documents as specified in Section 01780. The Contractor's land surveyor is to affix his signature and registration number to applicable record drawings certifying the accuracy of lines and grades shown.
- B. Submit survey record drawings before final completion as specified in Section 01770.

**END OF SECTION**

## **SECTION 01326**

### **PHOTOGRAPHS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Photographs required before, during and after construction to provide record of site conditions, construction progress, as-built features and significant planned/unplanned events.

##### **1.02 PHOTOGRAPHY**

- A. Employ a competent professional photographer to record this important factual information.
- B. Digital Camera
  - 1. Single lens reflex design
  - 2. 24 mega pixels or greater
  - 3. Nikon D7500 or equal
- C. Prepare color photographs, in both print and digital file format, as directed by the Construction Manager. All electronic files are to be furnished in jpeg format and stored on a flash drive.

#### **PART 2 - PRODUCTS**

##### **2.01 DELIVERABLE PRODUCTS**

- A. Provide electronic files, with 8-1/2" x 11" color printed page with thumbnail views and file name identification for each picture.
- B. Compile digital images on flash drive and provide with a descriptive index of the images.
- C. Index printed pages chronologically and provide in a three-ring binder.
- D. Label flash drive's and protect in an individual plastic case.

#### **PART 3 - EXECUTION**

##### **3.01 PRE-CONSTRUCTION PHOTOGRAPHS**

- A. Provide one hundred (100) preconstruction photographs prior to commencement of Work on the sites.
- B. Take at locations to be designated by the Construction Manager.
- C. Submit prior to beginning construction.

##### **3.02 DURING CONSTRUCTION PHOTOGRAPHS**

- A. Provide construction color photographs showing the progress of the Work.
- B. Take photos of all Work prior to being buried or covered, including piping, fittings, transitions, tie-ins and valves.

- C. Take photos of any significant planned or unplanned events.
- D. Take photos from the same four locations at monthly intervals to record progress of work from same vantage points. These vantage points will be determined by the Construction Manager.
- E. Not Used.
- F. Take a minimum of forty-eight (48) photographs every month during construction. Submit no more than one hundred (100) photographs each month.
- G. Submit photos with each month's Application for Payment.

### 3.03 AERIAL PHOTOGRAPHS

- A. Aerial photographs shall be taken by a professional aerial photographer service approved by the Construction Manager every months. Aerial photographs must be taken (1) prior to moving facilities onsite or starting construction; and (2) following the completion of all.
- B. Aerial photographs shall be by aerial camera with forward motion compensation.
- C. Aerial photographs shall provide coverage of the complete project site in an assembled mosaic.
- D. Take aerial photographs at the same altitude.

### 3.04 POST-CONSTRUCTION PHOTOGRAPHS

- A. Upon acceptance of the Work, provide one hundred (100) photographs of the Work where directed by the Construction Manager.
- B. Submit photographs as part of Contract Closeout.

### **END OF SECTION**

## **SECTION 01330**

### **SUBMITTALS**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

- A. Submittals covered by these requirements include manufacturers' information, shop drawings, test procedures, test results, samples, requests for substitutions, and miscellaneous work-related submittals. Submittals shall also include, but not be limited to, mechanical equipment and systems, materials, reinforcing steel, fabricated items, piping and valves.
- B. Furnish drawings, specifications, descriptive data, certificates, samples, test results, methods, schedules, manufacturer's installation instructions and other information to fully demonstrate that the materials and equipment to be furnished and the methods of work comply with the provisions and intent of the Contract Documents.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01782 – Operations and Maintenance Information
  - 2. Section 01999 – Reference Forms

##### **1.03 CONTRACTOR'S RESPONSIBILITIES**

- A. Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the materials and equipment incorporated into the Work, or the methods of performing the Work shall be as described in the accepted submittals.
- B. Contractor shall confirm on each submittal document that the Contractor has reviewed the submittal, verified field conditions, and complied with the contract documents.
- C. Verify that all features of all products conform to the specified requirements. Submittal documents shall be clearly edited to indicate only those items, models, or series of equipment that are being submitted for review. Extraneous materials shall be crossed out or removed.
- D. Coordinate submittals among subcontractors and suppliers. Ensure that there is no conflict with other submittals and notify the Engineer in each case where a submittal may affect the work of another contractor or the Owner, including those submittals complying with unit responsibility requirements specified in applicable technical sections.
- E. Coordinate submittals with the Work so that work will not be delayed. Coordinate and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another. No extension of time will be allowed because of failure to properly schedule submittals.
- F. Do not proceed with work related to a submittal until the submittal process is complete and the submittal has received a response "No Exceptions Taken" or "Make Corrections Noted."

#### 1.04 REVIEW COSTS

- A. The Owner's cost for review of submittals for the same proposed materials, equipment or work will be apportioned as follows:
  - 1. The cost of review of the initial submittal and the first revised submittal will be borne by the Owner.
  - 2. The cost to review all additional revised submittals after the first revised submittal will be charged to the Contractor. The cost of review shall include, without limitation, administrative, design, and engineering activities directly related to review of the submittals.
  - 3. If a submittal has been approved and the Contractor elects to submit an alternate item for review for the same application as the approved submittal, the Contractor shall be responsible for the review costs of the alternate submittal. The cost of the review shall include, without limitation, administrative, design, and engineering activities directly related to the review of the submittal.

#### 1.05 CATEGORIES OF SUBMITTALS

- A. General
  - 1. Submittals fall into two general categories;
    - a. Submittals for review and comment require action by the Engineer.
    - b. Submittals that are primarily for information only do not require Engineer's approval.
- B. Submittals for Review and Comment
  - 1. Transmit submittals for review and comment to the Engineer. The Engineer will review the submittal for compliance with the Contract requirements and will provide written comments regarding acceptability.
- C. Submittals for Information Only
  - 1. Where specified, furnish submittals to the Engineer for information only. The Engineer may, at the Engineer's option, review and comment on any product data.
  - 2. Incomplete or inadequate product data will be returned to the Contractor for resubmittal.

#### 1.06 SUBMITTAL LIST

- A. Within fifteen (15) days of the Notice to Proceed and prior to the submission of the initial shop drawing, submit a draft Master Submittal List of all required submittals to the Construction Manager for review.
- B. Include a description of each item, Specification and/or Drawing reference, and the anticipated submittal date. Arrange items on the list in the same order as in these Specifications. Provide sufficient data to identify material and equipment proposed, including manufacturers with whom purchase orders have been or will be placed.
- C. When the list has been approved and returned to the Contractor, the Master Submittal List shall become the basis for the submission of detailed manufacturer's drawings, catalog cuts, curves, diagrams, schematics, data, and information on each separate item for review.



1. No work shall proceed on any item until it has been submitted and favorably reviewed.
2. An incomplete submittal list is not a basis for avoiding a submittal required by the specifications.

#### 1.07 TRANSMITTAL PROCEDURE

##### A. General

1. Submittals for various items may be submitted as a single submittal when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
2. Provide a description of the submittal and the reference to the Contract requirement or Specification Section and paragraph number being addressed.

##### B. Forms

1. Unless otherwise specified, submittals regarding material and equipment shall be accompanied by Shop Drawing/Transmittal Form specified in Section 01999.
2. Submittals for operation and maintenance manuals shall be accompanied by Operation and Maintenance Transmittal Form specified in Section 01999.

##### C. Identifying Number

1. Assign a unique sequential number on the transmittal form accompanying each item submitted.
2. Use the following format for original submittal numbers: "#####-XXX"; where "#####" is the reference Contract Specification Section number and "XXX" is the sequential number assigned by the Contractor.
3. Use the following format for resubmittals: "#####-XXX-Y"; where "#####-XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 15050-25-B, for example, is the second resubmittal of submittal 15050-25.

##### D. Priority

1. The Contractor is encouraged to mark the submittal "high", "normal" or "low" priority to assist the reviewer in prioritizing the submittal reviews during periods of high volume of submissions.

##### E. Deviation from Contract

1. If the Contractor proposes to provide material, equipment, or method of work that deviates from the project manual, so indicate under "Proposed Deviations" on the transmittal form accompanying the submittal copies.

##### F. Submittal Completeness

1. Submittals that do not have all the information required to be submitted, including deviations, are not acceptable and will be returned without review.

## 1.08 SUBMITTAL FORMAT

### A. Electronic Submittals

1. Electronic submittals are preferred except as otherwise indicated.
2. Prepare electronic submittals and Shop Drawings in electronic (\*.pdf) format including half-sized and full-sized drawings, catalog information, and other required submittal information.
3. Break down submittals that are larger than 10 megabytes into smaller sections, using logical division points to create sections.
4. Electronically bookmark electronic submittals greater than 30 pages in length by major submittal section to facilitate ease of navigation.

### B. Paper Submittals

1. Hard copy submittals are an acceptable alternative to electronic submittals if the Contractor demonstrates, to the satisfaction of the Construction Manager, that electronic submittals presents a hardship.
2. If paper copy submittals are acceptable to the Construction Manager, submit four (4) copies of submittal information for review, unless otherwise specified.

## 1.09 SUBMITTAL CONTENT

### A. Prepare submittals in compliance with individual Specification Sections and as indicated herein.

### B. Annotated Specifications

1. Include a copy of the specification section with addendum updates, all referenced and applicable sections, and each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements.
  - a. Use check marks (✓) to denote full compliance with a paragraph as a whole.
  - b. If deviations from the specifications are indicated and, therefore requested by the Contractor, underline each deviation and denote by a number in the margin to the right of the identified paragraph.
  - c. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications.
  - d. Include a detailed, written justification for each deviation.
2. Failure to comply with this paragraph is sufficient cause to reject the entire submittal.

### C. Shop Drawings

1. Develop project-specific, scaled drawings to fully identify materials and products that will be provided and their relationship to other products that will be furnished and installed.
2. Do not use reproductions of the Contract Documents as the basis for the submittal.
3. Identify products, assemblies, equipment and systems.

4. Provide equipment identification numbers or tag numbers, wiring diagrams, and setting diagrams.
  5. Identify critical dimensions.
  6. Prior to submitting shop drawings, determine and verify all field measurements, elevations, potential conflicts, quantities, and dimensions. This verification may require potholing.
- D. Product Data
1. Provide information necessary to demonstrate conformance with the specified requirements.
  2. Product data shall be as specified in the individual Sections.
  3. Product data may consist of manufacturer's standard catalog information and data sheets, marked to indicate the specific products that will be provided.
  4. Provide supplemental information as necessary to fully demonstrate how products will be modified from the manufacture's standard products to meet the specification requirements.
- E. Manufacturer's Instructions
1. Provide written or published information that establishes the manufacturer's recommendations, guidelines, and procedures for handling and installation of products, equipment, and assemblies.
  2. Submit manufacturer's instructions prior to installation, erection, or application of equipment and other project components.
- F. Samples
1. Submit samples as specified in the individual Sections.
  2. Mount, display or package samples in a manner that will facilitate review and establish workmanship and quality of materials.
- G. Operation and Maintenance Data: As required in Section 01782.

## 1.10 REVIEW PROCEDURE

- A. General
1. The Engineer will review submittals within the processing time identified in paragraph "Processing Time" and return:
    - a. Electronic Submittal – a signed submittal response document, in (\*.pdf) format.
    - b. Paper Copy Submittal – One (1) marked up copy of the submitted copies. The reproducible original will be retained by the Engineer.
- B. Submittals for Review and Comment
1. The returned submittal will indicate one of the following actions:
    - a. "NO EXCEPTIONS TAKEN" – The material, equipment or work method complies with the project manual.

- b. "MAKE CORRECTIONS NOTED" – Limited corrections are required.
      - 1) Provide a corrected copy where:
        - a) The information is to be included in the O&M data.
        - b) If requested by the Engineer.
    - c. "AMEND AND RESUBMIT" – The submittal is insufficient or contains incorrect data.
    - d. "REJECTED – SEE REMARKS" – The material, equipment, or work method does not comply with the project manual. Submittals with deviations that have not been identified clearly may be rejected.
  - 2. For submittals marked "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."
    - a. The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with any noted corrections.
  - 3. For submittals marked "AMEND AND RESUBMIT" or "REJECTED – SEE REMARKS"
    - a. Contractor shall provide a typed letter responding to each of the Engineer's review comments with each resubmittal.
    - b. Except at its own risk, the Contractor shall not undertake the work covered by such submittals until a new submittal is submitted and returned marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED."
  - 4. If the submittal information does not require a review by the Engineer, copies of the submittal will be marked "Engineer's Review not Required" and will be returned without review.
- C. Submittals for Information Only
  - 1. Such information is not subject to submittal review procedures and shall be provided as part of the work under this contract and its acceptability determined under normal inspection procedures.
- D. Resubmittals
  - 1. Resubmittals shall explicitly address each comment provided from the review of the original submittal or previous resubmittal.
  - 2. Number resubmittals as indicated in Paragraph 1.07.C.
  - 3. Review procedure will be the same as outlined in Paragraph 1.10.B.

#### 1.11 PROCESSING TIME

- A. Prepare submittals and transmit to the Engineer for review in sufficient time to allow Engineer's review; manufacture, fabrication or assembly of materials and systems; and shipping of material to the site in time for installation in accordance with the Contractor's schedule. Allow adequate time in project schedule for the preparation and review of the submittal to ensure that the submittal will serve its intended purpose.
- B. Engineer's time for review will begin upon receipt of a complete and comprehensive submittal containing all required information.

- C. Engineer will review submitted information and transmit a response to Contractor within thirty (30) days after receipt, subject to the following:
  - 1. In some instances, review times for specific submittals may be modified by the individual specification Section.
  - 2. Resubmittals will be subject to the same review time.
- D. No adjustment of Contract Time or Contract Price will be allowed due to delays in the progress of the Work that are caused by rejected submittals and subsequent resubmittals.

#### 1.12 LIMITATIONS OF REVIEW OF CONTRACTOR'S SUBMITTALS

- A. The purpose of submittals is to demonstrate how Contractor intends to conform to the Contract Documents and design concepts. Engineer is entitled to rely upon the accuracy and completeness of designs, calculations, or certifications made by licensed professionals whether or not a stamp or seal is required by the Contract Documents.
- B. Review of contract drawings, methods of work, or information regarding materials or equipment the Contractor proposes to provide, does not relieve the Contractor of its responsibility for fulfilling the requirements of the Contract, proper operation of the equipment, or correction of defective work. Reviews shall not be regarded as an assumption of risk or liability by the Engineer or the Owner.
- C. A mark of "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED" means that the Owner has no objection to the Contractor, upon its own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.
- D. The Engineer's review of shop drawings, samples, or test procedures will be only for conformance with design concepts and for compliance with information given in Contract Documents. The Engineer's review does not extend to:
  - 1. Accuracy of dimensions, quantities, or performance of equipment and systems designed by Contractor.
  - 2. Contractor's means, methods, techniques, sequences, or procedures except when specified, indicated on the Drawings, or required by Contract Documents.
  - 3. Safety precautions or programs related to safety which shall remain the sole responsibility of the Contractor.
- E. Review of a separate item does not indicate approval of the assembly in which the item functions.
- F. The Construction Manager and/or Engineer shall not be required to review and shall not be responsible for any deviations from the contract documents not clearly noted by the Contractor, nor shall the Construction Manager and/or Engineer be required to review partial submissions or those for which submissions for correlated items have not been received.

#### 1.13 SUBSTITUTIONS OR "OR EQUAL" ITEMS

- A. Named or Sole Source Times
  - 1. Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the naming of the item is intended to establish the type, function, and quality required.

2. Unless the name designated a “sole source” and/or is followed by words indicating that no substitution is permitted, materials, or equipment of other Suppliers may be accepted by Engineer if sufficient information is submitted by Contractor to allow Engineer to determine that the material or equipment proposed is equivalent or equal to that named.

**B. Initiating Substitution Request**

1. To propose to furnish or use a substitute item of material or equipment, Contractor shall use the Proposed “Or Equal” Substitution Submittal Transmittal Form found in Section 01999.
2. Submit the Substitution Submittal form to Construction Manager for acceptance, certifying that the proposed substitute will perform adequately the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified.
3. State that the evaluation and acceptance of the proposed substitute will not prejudice Contractor’s achievement of Substantial Completion on time, whether acceptance of the substitute for use in the Work will require:
  - a. A change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for Work on the Project) to adapt the design to the proposed substitute.
  - b. Incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty.
4. Identify all variations of the proposed substitution from that specified
5. Identify available maintenance, repair, and replacement service
6. Provide an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including costs of redesign and claims of other contractors affected by the resulting change
7. The Owner or Engineer may require Contractor to furnish at Contractor’s expense additional data about the proposed substitute.
8. If a specific means, method, technique, sequence or procedure of construction is indicated in or required by the Contract Documents, Contractor may propose to furnish or utilize a substitute means, method, sequence, technique or procedure of construction. Submit sufficient information to allow Engineer to determine that the proposed substitution is equivalent to that indicated or required by the Contract Documents.

**C. Substitution Review Procedure**

1. The procedure for review of substitutions by Engineer will be similar to that provided in this Section.
2. Requests for substitutions may only be submitted by the Contractor.
3. All requests for substitution shall be submitted within thirty (30) calendar days after the date of Notice to Proceed unless the Owner has agreed in writing to a later submittal date and the Contractor agrees to comply with all conditions of the Owner for the late submittal.
4. The Owner’s agreement to a later submittal date shall not be construed as favorable review or acceptance of the proposed “or equal” substitution.

5. The Engineer will respond to all requests for substitutions within thirty (30) days following receipt of an acceptable substitution submittal, unless the Engineer notifies the Contractor within fourteen (14) days after receipt of the proposed “or equal” substitution submittal that more time is needed to complete a thorough review.
  6. The Engineer and Owner will be the sole judge of acceptability, and no proposed “or equal” substitution item or service will be ordered, installed or utilized without Engineer’s prior written acceptance that will be evidenced by either a Change Order or an accepted Shop Drawing.
  7. As a condition of acceptance, the Owner may require Contractor to furnish, at Contractor’s expense, a special performance guarantee or other surety with respect to a proposed “or equal” substitution item or service.
- D. Modification Due to Substitutions
1. All costs for redesign required by the implementation of the proposed substitute shall be borne by the Contractor.
  2. All costs associated with incorporating a substitution into the project shall be borne by the Contractor.

**PART 2 - (NOT USED)**

**PART 3 - (NOT USED)**

**END OF SECTION**

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## **SECTION 01340**

### **REQUESTS FOR INFORMATION AND CLARIFICATIONS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Procedures for submitting requests for information and clarifications when Contractor discovers apparent conflicts, omissions, or errors in the Contract Documents, or upon having any questions concerning interpretation of the Contract Documents.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01999 – Reference Forms

##### **1.03 PROCEDURES**

- A. Notification:
  - 1. Notify the Engineer in writing and request interpretation, clarification, or additional detailed instructions concerning the Work.
  - 2. Ask for clarification or request information immediately upon discovery, but no less than seven working days prior to the start date of the activities related to the clarification, based on the latest updated version of the official contract schedule.
- B. Form:
  - 1. Submit requests for clarification and/or additional information in writing to the Engineer using the Request for Information (RFI) form provided in Section 01999.
  - 2. Provide a detailed statement indicating the nature of the information requested. Reference specific Drawings and Specifications as appropriate.
  - 3. Limit each written request to one topic.
  - 4. Electronic (\*.pdf) format RFIs are preferred. Prepare RFIs and any attachments in electronic format. Transmit electronic RFIs via email to the Construction Manager. Break down RFIs that are larger than 4 megabytes into smaller sections, using logical division points to create sections.
  - 5. Hard copy RFIs are an acceptable alternative to electronic RFIs if the Contractor demonstrates, to the satisfaction of the Engineer, that electronic format presents a hardship. If hard copies are used, furnish six (6) copies of each RFI.
- C. Numbering:
  - 1. Use consecutive numbers for each new form submitted. When RFI's are re-submitted to request additional information on the same topic, add a letter A, B, C, etc. to the numbering system for each subsequent RFI until the subject is resolved.

#### 1.04 REASONS FOR SUBMITTAL

- A. Submit an RFI if one of the following conditions occur:
  - 1. An unforeseen condition or other circumstance that is not described in the Contract Documents.
  - 2. An apparent conflict or discrepancy between portions of the Contract Documents.
  - 3. An apparent omission from the Contract Documents.
  - 4. Information presented in the Contract Documents is unclear or additional details are needed to undertake the Work.

#### 1.05 RESPONSE TIME

- A. The Engineer will resolve the RFI and issue instruction to the Contractor within 7 calendar days.
- B. Response time may need to be lengthened; or shortened for emergency situations as mutually agreed upon by all parties.
- C. Do not proceed with the affected work before receipt of a response from the Engineer. Should the Contractor elect to proceed with the Work affected by the RFI, any portion of the Work that is not done in accordance with the Engineer's interpretation, clarifications, instructions or decisions will be subject to removal or replacement at the Contractor's expense.

#### 1.06 REJECTIONS

- A. RFI's submitted by the Contractor may be rejected by the Engineer for the following reasons:
  - 1. The RFI is submitted as a substitute for a submittal.
  - 2. Under the pretense of a Contract Documents discrepancy or omission without thoroughly reviewing the documents.
  - 3. In a manner that suggests that specific portions of the Contract Documents are assumed to be excluded, or be taken as an isolated portion of the Contract Documents in part rather than whole.
  - 4. In an untimely manner without proper coordination and scheduling of work or related trades.

#### 1.07 ADDITIONAL DETAILED INSTRUCTIONS (CLARIFICATIONS)

- A. The Owner may furnish additional detailed written instructions to further explain the Work and these instructions shall become part of the Contract Documents. Clarifications will be issued using the above RFI system.
- B. When, in the opinion of the Contractor, the Engineer's response in the RFI constitutes additional work beyond the scope of the Contract, the Contractor shall notify the Engineer in writing following receipt of the RFI and prior to initiating the Work affected by the RFI. The process for submitting claims of additional Work shall be followed as defined in the General Conditions. Lack of compliance with this notification requirement will cause Contractor to forfeit any claim for additional compensation or extension of the schedule.

### **END OF SECTION**

**SECTION 01400**  
**CONSTRUCTION STAKING**

**PART 1 - GENERAL**

**1.01 DATUM**

- A. Vertical and horizontal datum are based on the coordinates and benchmarks shown on the Drawings or as provided by Owner prior to the start of construction. Locate and protect Owner furnished control points prior to starting the Work and preserve control points during construction. Re-establish control points disturbed by operations at no cost to Owner.
- B. Establish other vertical and horizontal control from these reference points as required to properly layout and construct the Work. Install connections based on actual elevations of existing structures to which connections are made.

**1.02 ACCURACY OF INFORMATION**

- A. Dimensions for existing structures, piping, paving, and other nonstructural items are taken from the available information provided by the Owner. Field verify dimensions and conditions in advance of any construction in the area. Any discrepancy between the field survey by the Contractor and the information indicated in the Contract Documents shall be immediately brought to Engineer's attention by written notification.

**1.03 CONSTRUCTION STAKING**

- A. Construction staking will not be provided by the Engineer.

**1.04 LAYOUT AND MEASUREMENT TO BE PERFORMED BY CONTRACTOR**

- A. Contractor is responsible for conducting field surveys required to lay out components of the Work at the proper alignment, elevation, grades, dimensions, and distances indicated on the Drawings.
- B. Lay out the Work from the lines and grades provided by the Owner and from the dimensions and elevations provided on the Drawings. Contractor is responsible for measurements required for the execution of the Work.
- C. Furnish stakes, equipment, tools, materials, and labor as required for layout work.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

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## **SECTION 01450**

### **TESTING AND INSPECTIONS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Tests and inspections and allocation of responsibilities associated with tests and inspections.
- B. Tests and inspections covered in this Section do not include Special Inspections required by the International Building Code. Refer to Section 01455 for requirements pertaining to Special Inspections.
- C. The detailed tests and inspections required to be performed by the Contractor are specified in the individual Sections of Divisions 2 through 16.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01455 – Special Tests and Structural Observations

##### **1.03 TESTING AGENCY**

- A. Contractor shall employ and pay for testing conducted to confirm compliance with the requirements of the Contract. Testing may be on-site or off-site.
- B. The Testing Agency shall perform tests, inspections, and sampling of the following work:
  - 1. Earthwork, including collection and testing of representative material samples and compaction testing.
  - 2. Concrete placement, reinforcement, ingredients and quality control.
  - 3. Not Used
  - 4. Structural steel.
  - 5. Not Used
- C. The Owner's may also employ a Testing Agency.

##### **1.04 QUALITY ASSURANCE**

- A. Qualifications of Testing Agents: Agencies, bureaus, or laboratories shall be acceptable to the Engineer and shall meet the requirements ASTM E329.
- B. Failure of Materials and Equipment Tested or Inspected:
  - 1. The Contractor shall be pay for retesting and reinspection resulting from the Contractor's noncompliance with the Contract as evidenced by tests and inspections.
  - 2. Not Used

#### 1.05 TESTING AGENCY'S DUTIES

- A. Perform required inspecting, sampling and testing of materials and methods of construction.
  - 1. Comply with specified standards, other recognized authorities as specified.
  - 2. Check for compliance with Contract Documents.
- B. Promptly notify the Engineer and the Contractor of observed irregularities or deficiencies in the work.
- C. Promptly submit written reports to the Contractor and to Engineer. Include:
  - 1. Date of test, inspection or sampling; project title and number; testing agency's name and address; name and signature of inspector.
  - 2. Record of temperature and weather, identification of applicable specification Section, type of inspection or test performed, and reference to applicable standards and codes.
  - 3. Location of tests; sample locations; test results; and observation regarding compliance with Contract Documents.
- D. The testing agency is not authorized to release, revoke, alter or enlarge on the requirements of the Contract Documents, approve or accept any portion of the work, or perform any of the Contractor's duties.

#### 1.06 CONTRACTOR'S RESPONSIBILITIES

- A. Initiate and coordinate tests and inspections required by Contract Documents and public authorities having jurisdiction of the work.
- B. Notify the Testing Agency a sufficient time in advance (but no less than 48 hours) of the manufacture of materials to be supplied which, by requirements of the Contract Documents, must be tested at the source of supply so that the Laboratory may arrange for testing.
- C. When changes of construction schedule are necessary during construction, coordinate all such changes with the Testing Agency as required.
- D. When the Testing Agency is ready to test according to the established schedule, but is prevented from testing or taking specimens due to incompleteness of the work, all extra charges for testing attributable to the delay shall be borne by the Contractor.
- E. Provide access, facilities, tools, and labor necessary for duties to be performed at the site by the Testing Agency and Inspector, including furnishing ladders, hoisting, lighting, water supply and like services.
- F. Provide and maintain, for the sole use of the Testing Agency, adequate facilities for the safe storage and proper curing of concrete test cylinders on the Project site as required by ASTM C31.
- G. Furnish and deliver samples of materials to be tested at no extra cost to Owner. Test samples will be selected by the Inspector or Testing Agency and not by the Contractor.

- H. Reports:
1. Furnish copies of each test and inspection report, signed and certified by the Contractor's Testing Agency Supervising Engineer to the Contractor and to the Engineer.
  2. Within 48 hours, process and distribute the required copies of test reports and related instructions to assure necessary retesting and replacement of materials with the least possible delay in progress of the work.
- I. Records:
1. Maintain correct records on an appropriate form for all inspections and tests performed, instructions received from the Owner or testing agency, and actions taken as a result of those instructions.
  2. These records shall include evidence that the required inspections or tests have been performed (including type and number of inspections or tests, nature of defects, causes for rejection, etc.), proposed or directed remedial action, and corrective action taken.
  3. Document inspections and tests as required by each Section of the Specifications.
- J. If laws, ordinances, rules, regulations, or orders of public agency having jurisdiction require work to be inspected, tested or approved by some authority other than the Owner, or Contractor, the Contractor shall give required notices and make arrangements, deliver to the Owner the certificates of inspection, test, or approval of such public agency, and pay costs therefore unless otherwise provided in the Contract Documents.
- K. Completed Work: Should the Owner require tests and inspections for work completed before final acceptance of entire work, furnish necessary facilities, labor, and materials to uncover or remove work in question to extent necessary.
1. If such work is found defective due to fault of the Contractor, the Contractor shall defray expense of removal, test, and inspections, and satisfactory reconstruction. Time extension may not be granted.
  2. If such work is found to conform to requirements of the Contract, the Contractor shall be reimbursed by the Owner for facilities, labor and materials required for removal, and costs of satisfactory reconstruction in accordance with Contract amounts for extra work. Reasonable time extension shall be granted.

## 1.07 TEST PROCEDURES

- A. Testing:
1. The Testing Agency will perform tests according to method(s) of test specified in these Specifications.
  2. If no procedure or test method is specified, testing shall conform to material specification references unless otherwise directed by the Owner.
  3. The Testing Agency will tag, seal, label, record, or otherwise suitably identify the materials for testing. No materials shall be used in the work until the test reports are submitted and approved, excepting only the materials specified to be placed or installed prior to testing.

B. Retesting:

1. Repeat applicable tests at specified intervals, when:
  - a. The source of supply is changed.
  - b. The characteristics of the materials change or vary.
  - c. Unsatisfactory test results are received.
2. Quantity and nature of additional testing, if required, will be determined by the Owner.
3. Additional tests shall be taken in the presence of the Engineer.
4. Proof of non-compliance will make the Contractor liable for any corrective action which the Owner feels is prudent, including complete removal and replacement of defective materials.
5. Not Used.

1.08 PAYMENT FOR TESTING

- A. The Contractor will pay for testing services.

1.09 NOT USED

1.10 REQUEST FOR TESTING PROCEDURES

- A. Testing will be performed as ordered by the Owner's Representative. Contractor shall follow the Owner's Representative's procedures for requests for tests and inspections. Procedure are as follows:
1. Fill out the Request for Testing form provided by the Owner's Representative.
  2. Describe the test and the date the test is required. The request will be given to the Owner's Representative for approval.
  3. Submit the Request for Test at least forty-eight (48) hours in advance of the needed date for the test.
  4. The Owner's Representative will request the services from the testing agency.
  5. The testing agency will be provided a copy of the testing request which will be completed by the testing firm indicating the services provided.
  6. Provide a testing schedule which will be reviewed each week for the following week's work.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**



## SECTION 01455

### SPECIAL TESTS AND STRUCTURAL OBSERVATIONS

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Requirements for providing special tests and structural observations required by the International Building Code.
- B. The Contractor shall cooperate with the Owner and Engineer in performing Special Inspections of the Work.
- C. Special Inspections shall be performed by an agent under contract or employment by the Owner.

##### 1.02 SCHEDULE OF INSPECTIONS/OBSERVATIONS

- A. Special inspections and structural observations will be performed in accordance with Chapter 17 of the Building Code. The most recent version of the Code shall be utilized.
- B. Special inspections and tests are listed in Appendix A - Schedule of Special Inspections following this specification. Certain individual specification Sections may contain Special Inspections and tests specific to those sections.

##### 1.03 DEFINITIONS

- A. **Approved Agency:** An established and recognized agency regularly engaged in conducting tests or furnishing inspection services, when such agency has been approved by the Building Official.
- B. **Approved Fabricator:** An established and qualified person, firm, or corporation identified as such by AISC or the Building Official. Approval is based on written procedural and quality control manuals and periodic auditing of fabrication practices by an Approved Agency.
- C. **Building Official:** Owner's representative.
- D. **Continuous Special Inspection:** The full-time observation of Work by a Special Inspector who is present in the area where the Work is being performed as it is performed.
- E. **Fabricated Item:** Structural, load-bearing, or lateral load-resisting assemblies consisting of materials assembled prior to installation in a building or structure, or subjected to operations such as heat treatment, thermal cutting, cold working, or reforming after manufacture and prior to installation in the building or structure. Materials produced in accordance with standard specifications referenced in the Contract Documents or the Code, such as rolled structural steel shapes, steel-reinforcing bars, masonry units, and plywood sheets are not Fabricated Items.
- F. **Periodic Special Inspection:** The part-time or intermittent observation of Work by a Special Inspector who is present in the area where the Work has been or is being performed and at the completion of the Work.
- G. **Special Inspection:** Inspection as herein required of the materials, installation, fabrication, erection or placement of components and connections requiring special expertise to ensure

compliance with the Contract Documents and referenced standards. Special Inspection does not include, waive, or otherwise affect the Contractor's responsibility for inspections required by the Contract Documents.

- H. **Special Inspector:** An individual employed by an Approved Agency who is regularly engaged in conducting tests and furnishing Special Inspection services. The Special Inspector will be approved by the Building Official.

#### 1.04 SUBMITTALS

- A. When fabrication of assemblies that would otherwise require Special Inspection is done on an Approved Fabricator's premises, the following shall be submitted:
  - 1. At completion of fabrication, the Approved Fabricator shall submit to the Engineer and the Building Official a certificate of compliance stating that the Work was performed in accordance with the Contract Documents.

#### 1.05 CONTRACTOR RESPONSIBILITIES

- A. In performing the Work, the Contractor shall cooperate with the Special Inspector, so that the Special Inspections may be performed without hindrance.
- B. The Contractor shall review the Schedule of Special Inspections in Appendix A and individual specification sections and shall be responsible for coordinating and scheduling inspections. The Contractor shall notify the Engineer at least 48 hours in advance of a required Special Inspection.
- C. If any Work that is to receive any Special Inspection is covered without concurrence in writing from the Engineer, it shall be uncovered at the Contractor's expense unless the Contractor has given the notice required above and the Special Inspector has not acted with reasonable promptness to such notice. Removal and replacement of any finished Work damaged by the uncovering process or as required for corrective action shall be at the Contractor's expense.
- D. The Contractor shall furnish incidental labor and facilities for access to the Work to be inspected and shall facilitate inspections.
- E. The Contractor shall keep at the Site the latest set of Contract Drawings, field sketches, change orders, approved submittals, and specifications for use by the Special Inspector.
- F. The Special Inspection program shall in no way relieve the Contractor of this obligation to perform Work in accordance with the requirements of the Contract Documents or from implementing an effective Quality Control program.
- G. Contractor's quality control personnel shall first review all Work that is to be subjected to Special Inspection.
- H. Prior to the beginning of construction, the Contractor shall have a pre-construction meeting with the Engineer, Owner, Special Inspector to review the Special Inspection requirements.
- I. Contractor shall be responsible for the Special Inspection cost of any replacement and re-testing or re-inspection of Work that is determined to be Defective Work.

#### 1.06 INSPECTION OF FABRICATIONS

- A. When Work is performed on the premises of an Approved Fabricator, no Special Inspection is required.

#### 1.07 RECORDS AND REPORTS

- A. The Special Inspector will prepare detailed daily reports of each Special Inspection. Reports shall be submitted daily to the Owner and Engineer.
- B. Any deviations from the Contract Documents found during a Special Inspection will be immediately reported to the Contractor. If the discrepancies are not corrected promptly, the Special Inspector will notify the Engineer and Building Official. Daily reports will identify all discrepancies and the corrective actions taken.

#### 1.08 FINAL REPORTS OF SPECIAL INSPECTIONS AND STRUCTURAL OBSERVATIONS

- A. The Final Report of Special Inspections, completed by the Special Inspector, will be submitted to the Engineer and Building Official prior to issuance of a Certificate of Use and Occupancy.
- B. The Final Report of Special Inspections will certify that required inspections have been performed and will itemize any deviations that were not corrected or resolved.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## **APPENDIX A**

### **SCHEDULE OF SPECIAL INSPECTIONS**

Required inspections and tests are described in the following "Schedule of Special Inspections" and in the individual Specification Sections for the items to be inspected or tested.

#### **1.01 FABRICATORS**

- A. Where fabrication of structural load-bearing members and assemblies is performed at a fabricator's shop, no Special Inspection is required if the fabricator is an Approved Fabricator. If the fabricator is not, then Special Inspection will be required.

#### **1.02 STEEL CONSTRUCTION**

- A. Welding inspection will be in compliance with AWS D1.1.
- B. The Special Inspector will inspect the steel to verify compliance with the details on the Contract Drawings, such as bracing, stiffening, member locations and proper application of joint details at each connection.
- C. Installation of high strength bolts will be inspected periodically in accordance with American Institute of Steel Construction specifications and California Building Code.
- D. While the Work is in progress, the Special Inspector will determine that the requirements for bolts, nuts, washers, bolted parts, painting, and installation and tightening in such standards are met.
- E. For bolts requiring pretensioning, the Special Inspector will observe the pre-installation testing and calibration procedures when such procedures are required by the installation method or by the Contract Documents; determine that all plies of connected materials have been drawn together and properly snugged; and monitor the installation of bolts to verify that the procedure for tightening is proper. For joints required only to the snug tight condition, the Special Inspector will only verify that the connected materials have been drawn together and properly snugged.
- F. Monitoring of bolt installation for pretensioning will be performed on a periodic basis when the Contractor uses the turn-of-nut method with matchmarking techniques, the direct tension indicator method, or the alternate design fastener (twist-off bolt) method. Joints designed as snug tight will be inspected only on a periodic basis.
- G. Monitoring of bolt installation for pretensioning using the calibrated wrench method or the turn-of-nut method without matchmarking will be performed on a continuous basis.

#### **1.03 COLD-FORMED STEEL FRAMING**

- A. Cold-formed steel framing will have the following special inspections:
  - 1. Periodic Special Inspection during welding of elements of the seismic force-resisting system.
  - 2. Periodic Special Inspections for screw attachment, bolting, anchoring and other fastening of components within the seismic force-resisting system, including struts, braces, and hold-downs.

## REQUIRED VERIFICATION AND INSPECTION OF STEEL CONSTRUCTION

Verification And Inspection	Inspection		Referenced Standards
	Continuous	Periodic	
Material verification of high-strength bolts, nuts, and washers:		X	Applicable ASTM material Specifications; AISC ASD, Section A3.4; AISC LRFD, Section A3.3
<ul style="list-style-type: none"> <li>Identification markings conforming to ASTM standards indicated in the Contract Documents.</li> </ul>			
<ul style="list-style-type: none"> <li>Manufacturer's certificate of compliance required.</li> </ul>			
Inspection of high-strength bolting:			AISC LRFD Section M 2.5
<ul style="list-style-type: none"> <li>Bearing-type constructions</li> </ul>		X	
<ul style="list-style-type: none"> <li>Slip-critical connections</li> </ul>	X		
Material verification of structural steel:		X	ASTM A 6 or ASTM A568
<ul style="list-style-type: none"> <li>Identification markings conforming to ASTM standards indicated in the Contract Documents.</li> </ul>			
<ul style="list-style-type: none"> <li>Manufacturer's certified mill test reports required.</li> </ul>			
<ul style="list-style-type: none"> <li>Material verification of weld filler materials:</li> </ul>		X	AISC, ASD, Section A3.6; AISC LRFD, Section A3.5
<ul style="list-style-type: none"> <li>Identification markings conforming to AWS specification indicated in the Contract Documents.</li> </ul>			
<ul style="list-style-type: none"> <li>Manufacturer's certificate of compliance required.</li> </ul>			
Inspection of welding – Structural steel:			AWS D1.1 AISC Seismic AWS D1.3
<ul style="list-style-type: none"> <li>Complete and partial penetration groove welds.</li> </ul>	X		
<ul style="list-style-type: none"> <li>Multi-pass fillet welds.</li> </ul>	X		
<ul style="list-style-type: none"> <li>Single-pass fillet welds <math>\geq 5/16</math>-in (7.9 mm).</li> </ul>	X		
<ul style="list-style-type: none"> <li>Single-pass fillet welds <math>&lt; 5/16</math>-in (7.9 mm).</li> </ul>		X	
<ul style="list-style-type: none"> <li>Welded studs when used for structural diaphragms or composite systems.</li> </ul>			
Inspection of welding – Reinforcing steel:	X		AWS D1.4 ACI 318 - 3.5.2 CBC 1903.5.2
<ul style="list-style-type: none"> <li>Verification of weldability of reinforcing steel other than ASTM A 706</li> </ul>	X		
<ul style="list-style-type: none"> <li>Shear reinforcement.</li> </ul>	X		
<ul style="list-style-type: none"> <li>Other reinforcing steel.</li> </ul>		X	
Inspection of steel frame joint details for compliance with the Contract Documents		X	CBC 1704.3.2
<ul style="list-style-type: none"> <li>Details such as bracing and stiffening.</li> </ul>			
<ul style="list-style-type: none"> <li>Member locations.</li> </ul>			
<ul style="list-style-type: none"> <li>Application of joint details at each connection.</li> </ul>			

Verification And Inspection	Inspection		Referenced Standards
	Continuous	Periodic	
<ul style="list-style-type: none"> <li>Welded sheet steel for cold- formed steel framing members such as studs and joists.</li> </ul>		X	
<ul style="list-style-type: none"> <li>Welding of stairs and railing systems.</li> </ul>		X	
<ul style="list-style-type: none"> <li>Floor and deck welds.</li> </ul>		X	Floor and deck welds.

#### 1.04 CONCRETE CONSTRUCTION

- A. No Special Inspection will be required for minor sitework concrete and non-structural slabs on grade as approved by the Engineer.

#### REQUIRED VERIFICATION AND INSPECTION OF CONCRETE CONSTRUCTION

Verification And Inspection	Inspection		Referenced Standards
	Continuous	Periodic	
Inspection of reinforcing steel, including prestressing tendons, and placement.		X	ACI 318 - 3.5, 7.1-7.7
Inspection of reinforcing steel welding in accordance with inspection of steel table above.	X		AWS D1.4 ACI 318 - 3.5.2
Inspect bolts to be installed in concrete prior to and during placement of concrete.	X		
Verifying use of required design mix.		X	ACI 318 - Ch. 4 & 5.2-5.4
Sampling fresh concrete and performing slump, air content and determining the temperature of fresh concrete at the time of making specimens for strength tests.	X		ASTM C172 ASTM C31 ACI 318 - 5.6, 5.8
Inspection of concrete placement for proper application techniques.	X		ACI 318 - 5.9 & 5.10
Inspection for maintenance of specified curing temperature and techniques.		X	ACI 318 - 5.11-5.13
Post installed anchor installation.	X		Per ICC-ES Reports

## **SECTION 01500**

### **CONSTRUCTION FACILITIES AND UTILITIES**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Requirements for Contractor's temporary facilities at the job site and for the prosecution of the Work.

##### **1.02 CONTRACTOR'S CONSTRUCTION OFFICE**

- A. Maintain a suitable office at the site.
- B. Temporary office will be considered as the headquarters of the Contractor's representative whom is authorized to receive drawings, instructions, or other communication or articles. Any communication given to the representative or delivered at Contractor's temporary office at the site in his absence is deemed to have been delivered to the Contractor.
- C. Maintain copies of the Drawings, Specifications, and other Contract documents at Contractor's temporary office at the site and make these available for use at all times.

##### **1.03 STAGING AREA**

- A. Before starting the work, submit a proposed plan and layout for all temporary offices, sanitary facilities, storage areas, temporary water service and distribution, and temporary power service and distribution.
- B. Erect temporary security fence as appropriate. Contractor is responsible for the security of the staging area. Owner and Engineer do not take any responsibility for missing or damaged equipment, tools or personal belongings.
- C. Store only those materials and equipment that are related to the construction within the staging area.

##### **1.04 FENCES**

- A. Erect temporary fences at the boundary of construction easements and in locations indicated on the Drawings to protect existing sensitive areas.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION**

##### **3.01 TEMPORARY ELECTRIC POWER**

- A. Contractor shall make provisions to obtain temporary electric power for use during construction. The Contractor shall be responsible for obtaining a source of electric power for construction.
- B. Cost of electric power shall be borne by the Contractor.
- C. The temporary electric power installation shall meet the construction safety requirements of OSHA, state, and other governing agencies.

3.02 TEMPORARY TELEPHONE SERVICE

- A. Provide telephone service at the construction site office. Cellular telephone service is acceptable.
- B. The Contractor is not permitted to use the Owner's telephone service.

3.03 TEMPORARY SANITARY FACILITIES

- A. Provide toilet and wash-up facilities for the construction work force at the site of work.
- B. Facilities shall comply with applicable laws, ordinances, and regulations pertaining to the public health and sanitation of construction field offices, dwellings, and camps.

3.04 TEMPORARY WATER SUPPLY

- A. Use potable water for soil moisture conditioning, pipeline pressure testing and other construction uses.
- B. Obtain approvals and authorizations from the owner of the public water distribution system for use of water and pay all fees associated with consumption of the potable water.
  - 1. Make the necessary connections to the public water supply and install all conveyance piping and truck filling facilities that are required to transport water for the work.
  - 2. Temporarily install valves, flow meters, air gaps, backflow preventers and other appurtenances required by the owner of the public water distribution system to maintain the integrity of the existing water systems.
  - 3. Remove temporary water facilities when no longer needed.

**END OF SECTION**



## **SECTION 01505**

### **MOBILIZATION AND DEMOBILIZATION**

#### **PART 1 - GENERAL**

##### **1.01 MOBILIZATION**

- A. Mobilization shall consist of preparatory work and operations, including, but not limited to, those necessary for the movement of personnel, equipment, supplies, and incidentals to the site; for the establishment of all facilities necessary for work on the project; and for all other work and operations which must be performed, or costs incurred prior to beginning work, on the various items on the project site.
- B. Mobilization shall also include the construction of temporary access ways; temporary fencing; and the necessary preparatory work required to allow for the safe and stable movement of all vehicles that are required to construct the improvements as shown.

##### **1.02 DEMOBILIZATION**

- A. Demobilization shall consist of work and operations necessary to disband all mobilized items and clean up the site. The removal of all temporary access ways, signs, temporary fencing, and temporary facilities or works and the restoration of surfaces to an equal or better than existing condition shall also be included as part of demobilization.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

### **END OF SECTION**

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## **SECTION 01560**

### **ENVIRONMENTAL CONTROLS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Environmental controls to be maintained during construction.

##### **1.02 APPLICABLE LAWS AND REGULATIONS**

- A. Comply with applicable Federal, State and local environmental, health and safety laws and regulations.

##### **1.03 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 02240 – Dewatering

##### **1.04 SUBMITTALS**

- A. Comply with Section 01330.
- B. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
- C. Plan for disposal of waste materials and intended haul routes.
- D. Dust control plan.
- E. Erosion and Sediment Control Plan.

##### **1.05 SITE CLEANLINESS**

- A. Maintain work sites, staging areas, public roadways and private property clean and free of rubbish and debris. Remove materials and equipment from the site when they are no longer necessary for the Work.
- B. Keep buildings that are occupied by the Contractor clear of refuse and debris and in a reasonably neat condition.
- C. Upon completion of the work and before final acceptance, clear work areas of equipment, unused materials, and rubbish to present a clean and neat appearance.

##### **1.06 HAZARDOUS MATERIALS**

- A. Handle paints, solvents, and other construction materials with care to prevent contaminants from entering into sewers, storm drains, surface waters, or soils.
- B. Develop an emergency response plan for spills of sewage, paint, oil, and other hazardous materials.
- C. In the event of a spill, immediately notify the ENGINEER, OWNER and jurisdictional agencies. Take proper measures to clean up spills of hazardous materials in accordance

with the emergency response plan, State, Federal, and local regulations and manufacturer's recommendations.

#### 1.07 AIR POLLUTION CONTROL

- A. Contractor shall not discharge smoke, dust, and other contaminants into the atmosphere that violate the air pollution regulations for the area.
- B. Do not idle internal combustion engines for prolonged periods of time.
- C. Minimize dust nuisance by cleaning, sweeping and sprinkling work areas, exposed soil, and haul roads with water or by powered brushing.

#### 1.08 NOISE CONTROL

- A. Comply with local controls and noise level rules, regulations, and ordinances which apply to any work performed pursuant to the Contract. If the requirements of this Section are more restrictive than those of the local regulations, the requirements of this Section shall govern.
- B. Minimize noise from construction equipment.
  - 1. Whenever possible, utilize construction equipment powered by electric motors rather than diesel or gas driven engines.
  - 2. Locate construction equipment such as compressors and generators as far from sensitive receptors as feasibly possible. Erect temporary sound blankets around noisy equipment to mitigate noise propagation.
  - 3. Equip internal combustion engines with a muffler and provide a noise enclosure around stationary equipment such as engine-driven generators, welders, compressors, and pumps. Use "quiet package" and "hush" equipment.
  - 4. Do not start-up machines or equipment prior to or after the specified construction work hours.
- C. Noise Complaints: Should a specific noise impact complaint occur, Engineer has the prerogative to direct Contractor to implement one of the following noise mitigation measures at Contractor's expense:
  - 1. Relocate stationary construction equipment away from the affected property.
  - 2. Shut off idling equipment.
  - 3. Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
  - 4. Install temporary or portable acoustic barriers around stationary construction noise sources.
  - 5. Operate electric powered equipment using utility power.
- D. Amplified sounds such as telephone, loudspeakers, and other forms of loud communication that constitute a nuisance and potential disturbance shall not be used.

#### 1.09 DIRT AND MUD CONTROL

- A. Contractor is responsible for preventing dirt, mud, and debris from accumulating on streets, sidewalks, parking areas, or other paved surfaces and for maintaining the cleanliness of these areas.
  - 1. Track Out: Clean vehicle tires of mud and dirt before exiting the site.
  - 2. Cover all dump truck loads and other loads that may result in debris falling from the vehicle.
  - 3. Sweeping Paved Areas:
    - a. Maintain cleanliness of paved areas used by the Contractor for the duration of the project.
    - b. Sweep paved areas that have been used since the previous cleaning on at least a weekly basis, or more frequently when directed by the Engineer. Utilize regenerative air or vacuum pickup sweepers together with proper dust control methods to remove sediment, dust, dirt, and other matter from paved areas. Do not use excessive water resulting in mud on public streets.

#### 1.10 TREE AND PLANT PROTECTION (NOT USED)

#### 1.11 OIL SPILL PROTECTION AND CONTROL

- A. Store fuel and oil in accordance with requirements of the Uniform Fire Code and applicable National Fire Protection Association standards.
- B. Assume responsibility for the prevention, containment, and cleanup of spilled oil, fuel, and other petroleum products used in the Contractor's operations. Prevention, containment and cleanup costs shall be borne by the Contractor.
- C. Periodically inspect fuel hoses, lubricating equipment, hydraulically operated equipment, oil drums, and other devices for drips, leaks or signs of damage. Maintain and properly store to prevent spills and vandalism.
- D. Construct dikes around storage tanks, or locate tanks to prevent spills from escaping to surface waters or drainage ditches.
- E. Remove oils on land using sand, clay, sawdust or other absorbent material and dispose in an acceptable manner. Store waste materials in drums or other leak proof containers after cleanup and during transport to disposal.

#### 1.12 WATER POLLUTION CONTROL

- A. Divert sanitary sewage and non-storm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
- B. Prior to commencing excavation and construction, obtain Project Manager's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and stormwater flow, including dewatering pump discharges.
- C. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

1.13 EROSION, SEDIMENT, AND FLOOD CONTROL

- A. Provide, maintain, and operate temporary facilities to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.
- B. Comply with state and local requirements.
- C. Comply with Section 02240.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

## **SECTION 01600**

### **MATERIALS AND EQUIPMENT**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Materials, equipment and products incorporated into the work.

##### **1.02 MATERIAL AND EQUIPMENT REQUIREMENTS**

- A. Specified in individual specification Sections in Divisions 2 through 16.
- B. Specifications are minimum requirements and manufacturers' standard products may require modifications to meet the specified requirements.
- C. Provide products and equipment with all accessories, trim, finish, safety guards and other devices needed for a complete and operational installation.
- D. Products to be supplied in quantity shall be the same product from a single source to provide standardization and interchangeability.

##### **1.03 DEFINITIONS**

- A. Named Products: Items identified by manufacturer's product name and model number as indicated in the manufacturer's published product data.
- B. Materials: Products that are shaped, cut, worked, finished or otherwise fabricated or installed to form a part of the Work.
- C. Equipment: A product with working parts, whether motorized or manually operated, that requires connections such as wiring or piping.

##### **1.04 PACKAGING AND MARKING**

- A. Equipment shall be protected against damage from moisture, dust, handling, or other cause during transport from manufacturer's premises to site. Each item or package shall be marked with the number unique to the specification reference covering the item.
- B. Stiffeners shall be used where necessary to maintain shapes and to give rigidity. Parts of equipment shall be delivered in assembled or subassembled units where possible.
- C. Bearing housings, vents and other types of openings shall be wrapped or otherwise sealed to prevent contamination by dust and dirt.

##### **1.05 SHIPPING AND DELIVERY**

- A. Plan, order, coordinate and deliver materials and equipment in accordance with the construction schedule to avoid delays and conflicts with the Work.
- B. Deliver anchor bolts and bolt templates sufficiently early to permit setting and placement in structural concrete.
- C. Unload products in accordance with the manufacturer's handling instructions. Promptly inspect for completeness and evidence of damage during shipment.

## 1.06 HANDLING AND STORAGE

- A. During the interval between the delivery of equipment to the site and installation, all equipment, unless otherwise specified, shall be stored in an enclosed space affording protection from weather, dust and mechanical damage and providing favorable temperature, humidity and ventilation conditions to ensure against equipment deterioration. Manufacturer's recommendations shall be adhered to in addition to these requirements.
- B. Equipment and materials to be located outdoors may be stored outdoors if protected against moisture condensation. Equipment shall be stored at least 6 inches above ground. Temporary power shall be provided to energize space heaters or other heat sources for control of moisture condensation. Space heaters or other heat sources shall be energized without disturbing the sealed enclosure.
- C. Fabricated products, pipe and pipe appurtenances shall be handled, stored off the ground on blocking or skids. Pipes with paint, tape coatings, linings or the like shall be stored to protect the coating or lining from physical damage or other deterioration. Pipes shipped with interior bracing shall have the bracing removed only when recommended by the pipe manufacturer.
- D. Store loose granular products in well-drained area on a solid surface to prevent mixing with foreign matter. Cover products that are subject to erosion or deterioration with plastic sheeting.
- E. Store electrical, instrumentation and control products in a water-tight enclosure to protect against damage from moisture, dust and corrosion.

## 1.07 PROTECTION OF EQUIPMENT AFTER INSTALLATION

- A. After installation, protect equipment from damage from, including but not limited to, dust, abrasive particles, debris and dirt generated by the placement, chipping, sandblasting, cutting, finishing and grinding of new or existing concrete, terrazzo and metal; and from the fumes, particulate matter, and splatter from welding, brazing and painting of new or existing piping and equipment.
- B. As a minimum, vacuum cleaning, blowers with filters, protective shielding, and other dust suppression methods will be required at all times to adequately protect all equipment.
- C. When sandblasting or when finishing concrete, all equipment that may be affected by cement dust shall be completely covered. Electrical switchgear, substations and motor load centers shall not be installed until after all concrete work and sandblasting in those areas have been completed and accepted and the ventilation systems installed.
- D. During painting operations, all grease fittings and similar openings shall be covered to prevent the entry of paint.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION

### 3.01 INSPECTION

- A. Prior to installation, inspect materials and equipment for signs of corrosion and other effects of storage. Do not install material or equipment showing such effects.



- B. Remove damaged material from the site and expedite delivery of replacement material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays that are within the Contractor's control.

### 3.02 INSTALLATION

- A. Handle, install, connect, clean and adjust products in accordance with the manufacturer's instructions.
- B. Fill lubricant reservoirs and grease bearings prior to starting equipment. Use lubricants recommended by the manufacturer of the equipment.
- C. Recoat painted surfaces that are damaged prior to final acceptance of the Work.

### **END OF SECTION**

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## **SECTION 01610**

### **SEISMIC ANCHORAGE AND BRACING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Requirements for seismic anchorage and bracing for equipment, tanks and nonstructural components.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 01611 – Seismic Design Requirements
  - 3. Section 05501 – Anchor Bolts and Anchoring Devices
  - 4. Section 11000 – General Requirements for Equipment
  - 5. Section 11002 – Equipment Mounting
  - 6. Section 15097 – Seismic Restraints for Piping

##### **1.03 AREAS OF DESIGN RESPONSIBILITY**

- A. The Contractor shall be responsible for designing all seismic attachments, braces, and anchors to the structure for tanks, mechanical equipment and electrical equipment included in the Work that weigh more than 20 pounds.
- B. Equipment manufacturers may provide standard design calculations and details for their specific pieces of equipment as part of the submittal for that equipment. Project-specific design calculations and details need not be produced unless the manufacture does not already have standard designs already prepared.
- C. Design of seismic anchorage and bracing for piping systems and ventilation ducting is also included in the Contractor's responsibility for seismic design. Refer to Sections 15097 for additional requirements pertaining to seismic anchorage and bracing of piping and HVAC systems.

##### **1.04 REFERENCES**

- A. The following is a list of standards which may be referenced in this section.
  - 1. International Code Council (ICC)
    - a. International Building Code (IBC)
    - b. Evaluation Service (ICC-ES) Reports and Legacy Reports
  - 2. American Society of Civil Engineers (ASCE)
    - a. ASCE 7, Minimum Design Loads for Building and Other Structures.

##### **1.05 SUBMITTALS**

- A. Comply with Section 01330.

- B. Seismic Anchorage and Bracing Calculations
  - 1. Submit manufacturer's engineered seismic hardware data and installation requirements.
  - 2. Provide calculations for seismic attachments, braces and anchorages clearly showing the criteria used for the design. Calculations for anchorage of components shall be signed and sealed by a registered Professional Engineer.
- C. Shop Drawings: Show details of seismic attachment assemblies including connection hardware, bracing, and anchor bolts.

#### 1.06 DESIGN AND PERFORMANCE REQUIREMENTS

- A. In accordance with Oregon Structural Specialty Code, tanks, mechanical and electrical components, and other elements of the Work that are permanently attached to structures shall be designed and constructed to transfer the component seismic forces specified in ASCE 7, Chapter 13 to the structure.
- B. Seismic attachments, braces, and anchorages shall be designed in accordance with the provisions of the Oregon Structural Specialty Code and the site-specific seismic criteria in Section 01611
- C. Comply with Sections 11000 and 11002.
  - 1. Do not use more than 60 percent of the weight of tanks and mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
  - 2. Do not use friction to resist sliding due to seismic forces.
- D. In accordance with ASCE 7, the following are exempt from the requirements of this Section:
  - 1. Mechanical and electrical components with a Component Importance Factor of = 1.0 that weigh 400 pounds or less, are mounted 4 feet or less above the adjacent finished floor elevation, and are provided with flexible connections between the components and any associated ductwork, piping, or conduit.
  - 2. Mechanical and electrical components with a Component Importance Factor of = 1.0 that weigh 20 pounds or less, are mounted at any height, and are provided with flexible connections to attached ductwork, piping, and conduit.

### PART 2 - PRODUCTS

#### 2.01 MATERIALS

- A. Attachments and supports transferring seismic loads to the structure shall be constructed of materials and products suitable for the application and designed and constructed in accordance with the design criteria shown on the Drawings and nationally recognized standards.
- B. Do not use powder driven fasteners and sleeve anchors for seismic attachments and anchorages where resistance to tension loads is required.
- C. Anchor Bolts: In accordance with Section 05501.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Design seismic anchorage systems to provide restraint in all directions, for each component or system so anchored.
- B. Anchor tall and narrow equipment such as motor control centers and electrical control panels at the base and within 12 inches from the top of the equipment.
- C. Mechanical and electrical components shall not be attached to more than one element of a building structure at a single restraint location where such elements may respond differently during a seismic event. Such attachments shall also not be made across building expansion and contraction joints.
- D. Provide and install seismic attachments and braces in accordance with the size and number of braces determined by the design calculations prepared by the Contractor.
- E. Provide and install anchor bolts and concrete and masonry anchors for the anchorage of equipment in accordance with the bolt sizing, minimum embedment, and spacing requirements determined by the calculations prepared by the Contractor.

**END OF SECTION**

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**SECTION 01611**  
**SEISMIC DESIGN REQUIREMENTS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. The following primary and secondary structural system elements, non-structural components, and/or equipment supported by structures.
  - 1. Mechanical, electrical, and plumbing equipment and appurtenances.
  - 2. Un-buried Conduit, piping, cable trays, raceways, ducts and similar systems.
  - 3. Not Used.
  - 4. Light fixtures.

**1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 05501 – Anchor Bolts and Anchoring Devices

**1.03 REFERENCES**

- A. 2022 Oregon Structural Specialty Code (OSSC)

**1.04 DEFINITIONS**

- A. Engineer of Record: The Engineer responsible for the preparation of Contract Documents.
- B. Specialty Engineer: Structural or Civil Engineer provided by the Contractor licensed in the State where the project is being built responsible for specific elements of the primary structural system, the secondary structural system, non-structural elements and/or equipment supported by structures.

**1.05 GENERAL DESIGN REQUIREMENTS**

- A. The Contractor is responsible for producing designs that resist the total seismic forces in accordance with the seismic design criteria.
- B. The Contractor is responsible for coordinating between the Engineer of Record and the Specialty Engineer.
- C. The seismic design for non-structural components and equipment shall be in accordance with the OSSC Chapter 16, and the required coefficients and factors for determining the total design seismic forces are provided in the Seismic Design Criteria in Paragraph D below.
- D. Coordinate the layout so that adequate space is provided between items for relative motion. Provide additional supports and restraints between items of different systems when necessary to prevent seismic impacts or interaction.
- E. Seismic forces shall be determined in accordance with the following seismic design criteria:

1. Site-Specific Spectral Response Coefficients
  - a. Short Period Mapped Maximum Considered Earthquake, 5 Percent Damped:  $S_s=0.79g$
  - b. Short Period Mapped Maximum Considered Earthquake, 5 Percent Damped:  $S_1=0.36g$
  - c. Short Period Design Spectral Response Acceleration, 5 percent Damped:  $SDS = 0.72$
  - d. 1 Second Period Design Spectral Response Acceleration, 5 percent Damped:  $SD_1 = 0.53$
2. Site Class: D
3. Seismic Design Category: D, unless noted otherwise
4. Risk Category: III, unless noted otherwise
5. Component Importance Factor,  $I_p$ :
  - a. Mechanical and Electrical Equipment: Use 1.25.
  - b. Tanks and Tank Anchorage: Use 1.25.
  - c. Components that contain hazardous materials: Use 1.25.
  - d. Components that are required for life safety: Use 1.25.
  - e. Components that must remain functional after an earthquake, such as fire protection sprinkler systems: Use 1.25.
6. Do not use more than 60 percent of the weight of tanks and mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
7. Do not use friction to resist sliding due to seismic forces.

#### 1.06 DESIGN REQUIREMENTS FOR PIPING, CONDUIT, AND DUCTS

- A. The Contractor is responsible for producing designs for support of piping, conduit, duct or other systems to resist total seismic forces based on the seismic design criteria coefficients specified above, unless shown on the Contract Documents. Except where the technical specifications give specific exemption from resistance of seismic forces, all supports shall be designed to meet seismic criteria.
- B. Where possible, pipes, conduit, and their connections shall be constructed of ductile materials (e.g., copper, ductile iron, steel or aluminum and brazed, welded or screwed connections). Pipes, conduits and their connections, constructed of nonductile materials (e.g., cast iron, no-hub pipe and plastic), shall have the brace spacing reduced to one-half of the spacing allowed for ductile material.
- C. Seismic restraints may be omitted for the following conditions, where flexible connections are provided between components and the associated ductwork, piping and conduit:
  1. Where the nominal pipe size is 1 in. or less.
  2. Piping, conduit or ducts suspended by individual hangers 12 inches or less in length from the top of the component to the bottom of the structural support. Where rod hangers are used, they shall be equipped with swivels.
  3. Air-handling ducts less than 6 square feet in cross-sectional area.



4. See the OSSC for additional requirements related to the omitting of seismic bracing.
- D. All trapeze assemblies supporting pipes, ducts and conduit shall be braced to resist the total seismic forces considering the weight of the elements on the trapeze. Pipes, ducts and conduit supported by a trapeze where none of those elements would individually be braced need not be braced if connections to the pipe/conduit/ductwork or directional changes do not restrict the movement of the trapeze. If this flexibility is not provided, bracing will be required when the aggregate weight of the pipes and conduit exceed 10 pounds/foot. The weight shall be determined assuming all pipes and conduit are filled with water.
- E. As an alternative to designing the supports and anchorage, where an approved national standard provides a basis for the earthquake-resistant design, submit standard, data, and details for piping, conduit, duct or other systems:
  1. For ductwork, mechanical piping, process piping and electrical conduits, follow Guidelines for Seismic Restraints of Mechanical Systems by SMACNA modified as follows:
    - a. Seismically brace piping regardless of size or location. Provide transverse braces at all changes in direction and at the end of all pipe runs. Space transverse braces not more than 20 feet apart. Provide longitudinal braces at 40-foot centers.
    - b. Seismically brace all ductwork regardless of size or location. Provide transverse braces at all changes in direction and at each end of run. Space braces not over 20 feet apart. Provide longitudinal braces at 40-foot centers.
  2. For fire protection systems, follow NFPA 13 modified as in Paragraph 1.b above. Ensure that no seismic interaction occurs with items of other systems.

#### 1.07 DESIGN REQUIREMENTS FOR UNDERWATER ITEMS

- A. To allow for water sloshing, design rigid items such as piping or equipment supports for twice the lateral force, computed as if the item were above water. Alternatively, include seismic forces due to hydrodynamic forces in the analysis.
- B. Design flexible items to accommodate sloshing motions without damage to rigid machinery.
- C. Provide retainers to hold items from falling and damaging rotating equipment below, if bolted connections will fail because of ground motion displacing the supports.

#### 1.08 SUBMITTALS

- A. Comply with Section 01330.
- B. Shop Drawings: Submit structural calculations and detailed drawings signed and sealed by a structural engineer for the elements and where required in Divisions 2 through 16 of the primary structural system and their attachments, the secondary structural system and their attachments, permanent non-structural components and their attachments, and the attachments and anchorage for all permanent equipment supported by the structures.
- C. Structural calculations and detailed drawings shall be prepared by a Specialty Engineer licensed in the State where the project is being built.

- D. Structural calculations and detailed drawings shall clearly show the total design seismic forces which will be transferred from the elements of the structural system, non-structural components, and/or equipment and their attachments to the primary structure.
- E. The Engineer's review of items within a Specification Section cannot be completed until all related items have been coordinated and submitted for review.
- F. Quality Assurance Submittals
  - 1. Test Reports: Submit test reports for tension testing of anchors.
  - 2. Where required in the equipment specifications in Divisions 2 through 16 submit certification that the equipment itself is designed to resist all internal seismic forces based on the seismic design criteria for the project.
  - 3. Where required in the equipment specifications in Divisions 2 through 16, submit signed and sealed structural calculations and detailed drawings from a specialty Structural or Civil Engineer licensed in the State where the project is being built for the attachments and anchorage to the primary structure.
  - 4. Where required in the equipment specifications in Divisions 2 through 16, submit certification that the attachments and anchorage are designed to resist all seismic forces based on the seismic design criteria for the project.

#### 1.09 QUALITY ASSURANCE

- A. Qualifications: The Contractor is responsible for submitting signed and sealed structural calculations and detailed drawings from a Specialty Structural or Civil Engineer licensed in the State where the project is being built.
- B. Regulatory Requirements: Comply with the State of Oregon adopted and amended versions of OSSC plus clarifications and additions specified in this Section.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### 3.01 FIELD QUALITY CONTROL

- A. Site Tests:
  - 1. Tension testing of expansion or adhesive anchors utilized for anchorage shall be done in the presence of the special inspector and a report of the test results shall be submitted.
  - 2. See Section 05501 for additional requirements.
- B. Inspection:
  - 1. Provide special inspection for high strength bolting or bolts installed in concrete.
  - 2. See Section 05501 for additional requirements.

### **END OF SECTION**

**SECTION 01615**  
**WIND DESIGN CRITERIA**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. The following primary and secondary structural system elements, non-structural components, and/or equipment supported by structures.
  - 1. Mechanical, electrical, and plumbing equipment and appurtenances.
  - 2. Un-buried Conduit, piping, cable trays, raceways, ducts, and similar systems.
  - 3. Un-buried tanks and vessels (include contents), including support systems.
- B. Storage racks, suspended ceilings, light fixtures, raised floors, partitions, storefronts, windows, louvers, architectural features and other non-structural components.

**1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 05501 – Anchor Bolts and Anchoring Devices

**1.03 REFERENCES**

- A. Oregon Structural Specialty Code (OSSC), current governing edition.

**1.04 DEFINITIONS**

- A. Engineer of Record: The Engineer responsible for the preparation of Contract Documents.
- B. Specialty Engineer: Structural or Civil Engineer provided by the Contractor licensed in the State where the project is being built responsible for specific elements of the primary structural system, the secondary structural system, non-structural elements and/or equipment supported by structures.

**1.05 GENERAL DESIGN REQUIREMENTS**

- A. The Contractor is responsible for producing designs that resist the total wind forces in accordance with the wind design criteria.
- B. The Contractor is responsible for coordinating between the Engineer of Record and the Specialty Engineer.
- C. The wind design for non-structural components and equipment shall be in accordance with the OSSC Chapter 16, and the required coefficients and factors for determining the total design wind forces are provided in the Wind Design Criteria in Paragraph E below.
- D. Coordinate the layout so that adequate space is provided between items for relative motion. Provide additional supports and restraints between items of different systems when necessary to prevent wind impacts or interaction.
- E. Design in accordance with the requirements of the following:
  - 1. Risk Category: III
  - 2. Basic Wind Speed:  $V = 105$  mph.

3. Wind Exposure Category: B
4. Wind Importance Factor:  $I = 1.0$

#### 1.06 SUBMITTALS

- A. Comply with Section 01 33 00.
- B. Shop Drawings: Submit structural calculations and detailed drawings signed and sealed by a civil or structural engineer for the following listed elements and where required in Divisions 2 through 16 of the primary structural system and their attachments, the secondary structural system and their attachments, permanent non-structural components and their attachments, and the attachments and anchorage for all permanent equipment supported by the structures.
  1. Electrical and Information Technology Equipment
  2. Standby Generators
- C. Structural calculations and detailed drawings shall be prepared by a Specialty Engineer licensed in the State where the project is being built.
- D. Structural calculations and detailed drawings shall clearly show the total design wind forces which will be transferred from the elements of the structural system, non-structural components, and/or equipment and their attachments to the primary structure.
- E. The Engineer's review of items within a Specification Section cannot be completed until all related items have been coordinated and submitted for review.
- F. Quality Assurance Submittals
  1. Test Reports: Submit test reports for tension testing of anchors.
  2. Where required in the equipment specifications in Divisions 2 through 16 submit certification that the equipment itself is designed to resist all internal wind forces based on the wind design criteria for the project.
  3. Where required in the equipment specifications in Divisions 2 through 16, submit signed and sealed structural calculations and detailed drawings from a specialty Structural or Civil Engineer licensed in the State where the project is being built for the attachments and anchorage to the primary structure.
  4. Where required in the equipment specifications in Divisions 2 through 16, submit certification that the attachments and anchorage are designed to resist all wind forces based on the wind design criteria for the project.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION (NOT USED)**

#### **END OF SECTION**

## **SECTION 01735**

### **CUTTING AND PATCHING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Cutting and patching existing and new construction.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals

##### **1.03 GENERAL REQUIREMENTS**

- A. Perform Work in compliance with OSHA Standards and other standards as applicable.
- B. Cutting and patching shall be completed to the satisfaction of the Engineer.

##### **1.04 SUBMITTALS**

- A. Submit in accordance with Section 01330.
- B. Cutting and Patching Plan
  - 1. Submit details of proposed construction before cutting and patching construction commences affecting:
    - a. Work of Owner or of others.
    - b. Structural integrity of element of Project.
  - 2. Cutting and Patching Plan shall include the following for Engineer's approval:
    - a. Identification of Work.
    - b. Description of affected construction.
    - c. Necessity for cutting, patching, alteration, or excavation.
    - d. Description of proposed construction.
    - e. Scope of cutting, patching, alteration, or excavation.

#### **PART 2 - PRODUCTS**

##### **2.01 MATERIALS**

- A. Comply with specifications and standards for products involved.

#### **PART 3 - EXECUTION**

##### **3.01 PREPARATION**

- A. Provide adequate temporary support as necessary to ensure structural integrity of affected portion of Work.
- B. Provide devices and methods to protect other portions of Project from damage and persons from injury.

- C. Provide protection from elements for that portion of Project which may be exposed by cutting and patching, and maintain excavations free from water.

### 3.02 CUTTING AND PATCHING

- A. Cut, Fit, and Patch when required to
  - 1. Make its several parts fit together properly.
  - 2. Remove and replace construction not conforming to Contract Documents.
  - 3. Remove samples of installed construction as specified for testing.
  - 4. Provide routine penetrations of nonstructural surfaces for installation of piping and electrical conduit.
- B. Execute cutting and demolition by methods which will prevent damage and will provide proper surfaces to receive installation of repairs.
- C. Openings in Existing Concrete
  - 1. Create openings by:
    - a. Saw cutting completely through concrete or masonry, or
    - b. Scoring edges of opening with saw to at least 1 inch depth on both surfaces (when accessible) and removing concrete or masonry by chipping.
  - 2. Do not allow saw cuts to extend beyond limits of opening.
  - 3. Make corners square and true by combination of core drilling and grinding or chipping.
  - 4. Prevent debris from falling into adjacent tanks or channels in service or from damaging existing equipment and other facilities.
- D. Sizing of Openings in Existing Concrete
  - 1. Make openings sufficiently large to permit final alignment of pipe and fittings without deflections.
  - 2. Allow adequate space for packing around pipes and conduit to ensure watertightness.
- E. Grouting Pipes in Place
  - 1. Sandblast concrete surfaces and thoroughly clean sand and other foreign material from surfaces prior to placing grout.
  - 2. Grout pipes, sleeves, castings, and conduits in place by pouring grout under a head of at least 4 inches. Vibrate grout into place. Completely fill the spaces occupied by pipes, sleeves, castings, and conduits.
  - 3. Water cure the grout.
- F. Connections to Existing Pipes
  - 1. Cut existing pipe square.
  - 2. Properly prepare the ends for the connection indicated on the Drawings.
  - 3. Repair any damage to existing lining and coating.

- G. Rehabilitate all areas affected by removal of existing equipment, equipment pads and bases, piping, supports, electrical panels, electric devices, and conduits such that little or no evidence of the previous installation remains.
1. Fill areas in existing floors, walls, and ceilings from removed piping, conduit and fasteners with non-shrink grout and finish smooth.
  2. Remove concrete bases for equipment and supports by:
    - a. Saw cutting clean, straight lines with a depth equal to the concrete cover over reinforcement minus 1/2 inch below finished surface. Do not cut existing reinforcement on floors.
    - b. Chip concrete within scored lines and cut exposed reinforcing steel and anchor bolts.
    - c. Patch with non-shrink grout to match adjacent grade and finish.
      - 1) Terminate abandoned piping and conduits with blind flanges, caps, or plugs.
- H. Treat Existing Concrete Reinforcement as follows:
1. Where existing reinforcement is to remain, protect, clean, and extend into new concrete.
  2. Where existing reinforcement is not to be retained, cut off as follows:
    - a. Where new concrete joins existing concrete at the removal line, cut reinforcement flush with concrete surface at the removal line.
    - b. Where concrete surface at the removal line is the finished surface, cut reinforcement 2 inches below the surface, paint ends with epoxy, and patch holes with dry pack mortar.

**END OF SECTION**

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## **SECTION 01740**

### **CLEANING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Intermediate and final cleaning of Work not including special cleaning of closed systems specified elsewhere.

##### **1.02 STORAGE AND HANDLING**

- A. Store cleaning products and cleaning wastes in containers specifically designed for those materials.

##### **1.03 SCHEDULING**

- A. Schedule cleaning operations so that dust and other contaminants disturbed by cleaning process will not fall on newly painted surfaces.

#### **PART 2 - PRODUCTS**

##### **2.01 MATERIALS**

- A. Cleaning Agents
  - 1. Compatible with surface being cleaned.
  - 2. New and uncontaminated.
  - 3. For Manufactured Surfaces: Material recommended by manufacturer.

#### **PART 3 - EXECUTION**

##### **3.01 GENERAL**

- A. Prevent accumulation of wastes that create hazardous conditions.
- B. Conduct cleaning and disposal operations to comply with laws and safety orders of governing authorities.
- C. Do not dispose of volatile wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains or sewers.
- D. Dispose of degradable debris at an approved solid waste disposal site.
- E. Dispose of non-degradable debris at an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
- F. Handle materials in a controlled manner with as few handlings as possible.
- G. Do not drop or throw materials from heights greater than 4-feet or less if conditions warrant greater care.
- H. On completion of work, leave area in a clean, natural looking condition. Remove all signs of temporary construction and activities incidental to construction of required permanent Work.

- I. Do not burn on-site.

### 3.02 INTERIOR CLEANING

#### A. Cleaning During Construction

1. Keep work areas clean so as not to hinder health, safety or convenience of personnel in existing facility operations.
2. At maximum weekly intervals, dispose of waste materials, debris, and rubbish.
3. Vacuum clean interior areas when ready to receive finish painting. Continue vacuum cleaning on an as-needed basis, until final cleaning.

#### B. Final Cleaning

1. Complete immediately prior to Final Inspection.
2. Remove grease, mastic, adhesives, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed surfaces.
3. Wipe all lighting fixture reflectors, lenses, lamps and trims clean.
4. Wash and shine glazing and mirrors.
5. Polish glossy surfaces to a clear shine.
6. Not Used
7. Replace all burned out lamps.
8. Broom clean process area floors.
9. Mop office and control room floors.

### 3.03 EXTERIOR SITE CLEANING

#### A. Cleaning During Construction

1. Construction debris
  - a. Confine in strategically located container(s):
    - 1) Cover to prevent blowing by wind.
    - 2) Haul from site minimum once a week.
  - b. Remove from work area to container daily.
2. Vegetation
  - a. Keep weeds and other vegetation trimmed to 3-inch maximum height.
3. Soils, sand, and gravel deposited on paved areas and walks:
  - a. Remove as required to prevent muddy or dusty conditions.
  - b. Do not flush into storm sewer system.

#### B. Final Cleaning

1. Remove trash and debris containers from site:
  - a. Re-seed areas disturbed by location of trash and debris containers.
2. Clean paved roadways.

3.04 FIELD QUALITY CONTROL

- A. Immediately prior to Commissioning, conduct an inspection with Engineer to verify condition of all work areas.

**END OF SECTION**

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## **SECTION 01770**

### **CONTRACT CLOSEOUT PROCEDURES**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Administrative and procedural requirements for contract closeout.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. General Conditions
  - 2. Section 01780 – Record Drawings
  - 3. Section 01782 – Operation and Maintenance Information

##### **1.03 FINAL CLEANING**

- A. Immediately prior to submittal of a request for inspection for Substantial Completion, clean the project site and make ready for Owner's use and occupancy.
- B. Employ experienced workers or professional cleaners for final cleaning.
- C. Complete the following cleaning operations:
  - 1. Clean the project site, yard and grounds which were disturbed by construction activities. Remove rubbish, waste material, litter and other foreign material.
  - 2. Sweep paved areas, remove oil stains, grease, dust and dirt.
  - 3. Remove tools, construction equipment, machinery, storage sheds, temporary fences and surplus material.
  - 4. Broom clean sidewalks and concrete floors.
  - 5. Vacuum carpets, spot clean or if necessary, shampoo to remove visible soil or stains.
  - 6. Clean glass in doors and windows, remove glazing compounds, replace chipped and broken glass, clean door and window frames.
  - 7. Patch, touch up and repair marred surfaces and finishes. Replace finishes and surfaces that cannot be satisfactorily repaired or restored.
  - 8. Wipe surfaces of mechanical and electrical equipment, remove excess lubrication, paint splatter and mortar droppings.
  - 9. Clean plumbing fixtures and mirrors.
  - 10. Clean light fixtures, lamps and bulbs. Replace burned-out bulbs and defective or noisy starters in fluorescent and mercury vapor fixtures.

#### 1.04 SUBSTANTIAL COMPLETION

- A. General:
  - 1. Comply with procedural requirements for Substantial Completion as specified in the General Conditions.
- B. Complete final cleaning operations before requesting inspection for Substantial Completion.
- C. Prior to requesting inspection for Substantial Completion, complete and submit the following:
  - 1. List of items to be completed or corrected (punch list). Organize list by facility, space, system and piece of equipment.
  - 2. Specific warranties, bonds, maintenance service agreements, final certifications and similar documents.
  - 3. Delivery of spare parts, special tools, extra materials and similar items to designated locations.
  - 4. Make final changeover of permanent locks and deliver keys to Owner.
- D. Inspection for Substantial Completion:
  - 1. Engineer, Owner and Contractor shall jointly walk through and inspect the project site to determine whether the Work is satisfactory and Substantially Complete.
  - 2. The Contractor's punch list will be reviewed and additional items identified during the inspection requiring corrective actions will be added to the list as determined by the inspection.
  - 3. Once Substantial Completion has been achieved, Engineer will prepare a Certificate of Substantial Completion.

#### 1.05 FINAL COMPLETION

- A. Final Completion Submittals:
  - 1. Prior to submitting final Application for Payment, complete and submit the following:
    - a. Project Record Drawings. Refer to Section 01780.
    - b. Guaranty and Warranties.
    - c. Operation and Maintenance Information. Refer to Section 01782.
    - d. Punch List with all corrective actions completed and ready for Final Inspection.
    - e. Releases from Agreements with property owners or public agencies.
    - f. Releases or Waivers of Liens and Claims.
    - g. Evidence of final, continuing insurance coverage complying with insurance requirements.
    - h. Consent of Surety to Final Payment.
- B. Final Inspection:
  - 1. Submit written request for final inspection for Project Acceptance.

2. Engineer will either proceed with the inspection or advise Contractor of unfulfilled requirements.
3. Engineer will prepare a Certificate of Final Completion after satisfactory inspection of the Work.

1.06 FINAL APPLICATION FOR PAYMENT

- A. Following a satisfactory Final Inspection and receipt of a signed Certificate of Final Completion from the Engineer, submit the final Application for Payment in accordance with the procedures and requirements specified in the General Conditions.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

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**SECTION 01780**  
**RECORD DRAWINGS**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Record Drawings are documents maintained and annotated by the Contractor during construction to illustrate the final location of piping, equipment, electrical conduits, outlet boxes and cables.
- B. Record changes or deviations that vary from the details indicated on the original Contract Documents. Identify buried or concealed construction and utility features that are revealed during the course of construction. Record the horizontal and vertical location of buried utilities that differ from the locations indicated, or which were not indicated on the Contract Documents.
- C. When the configuration and arrangement of the Work is changed from that indicated on the Contract Drawings or specified in the Project Manual, the authorizing document for the change, such as a Request for Information, Change Order, Shop Drawing, or Field Order, shall be clearly referenced on the Record Drawings as a comment.
- D. Supplement the Record Drawings with detailed layout sketches, schedules, installation drawings and fabrication drawings.

**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION**

**3.01 RECORD DRAWINGS**

- A. Record Drawings shall be full size and maintained in a clean and legible condition. Engineer will provide one set of full size Drawings for use as a Record Drawing set.
- B. Do not use the Record Drawing set for construction purposes.
- C. At the completion of the work, but prior to final payment, submit the Record Drawing set to the Engineer.
- D. Marking of the drawings shall be kept current and shall be done at the time the material and equipment are installed.
- E. Annotations to the Record Drawings shall be legible and shall be made with an erasable colored pencil conforming to the following color code:
  - 1. Additions and Final Dimensions – Red
  - 2. Deletions – Green
  - 3. Comments – Blue
- F. Engineer will review the Contractor's updated Record Drawing mark-ups on a monthly basis during the evaluation of each progress payment.
  - 1. Progress payment approval is contingent upon complete and up-to-date Record Drawing mark-ups.

2. Payment approval will be delayed if mark-up drawings are not up-to-date.

**END OF SECTION**

## **SECTION 01782**

### **OPERATION AND MAINTENANCE INFORMATION**

#### **PART 1 - GENERAL**

##### **1.01 GENERAL**

- A. O&M information shall be provided for each maintainable piece of equipment, equipment assembly or subassembly, and material provided or modified under this Contract.
- B. Contractor shall be responsible for:
  - 1. Compiling product data and related information appropriate for the Owner's operation and maintenance of products furnished under the Contract.
  - 2. Preparing operating and maintenance data as specified in this Section and as referenced in other pertinent Sections of specifications for products furnished under the Contract.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals

##### **1.03 SUBMITTALS**

- A. Submit in accordance with Section 01330.
- B. Submit 2 manuals for review for each piece of equipment or system. Engineer and Owner will review the manuals and both will be returned to the Contractor. Make additions and revisions in accordance with the review comments and submit 4 final O&M Manuals.
- C. O&M Manuals must be submitted and accepted before on-site training may start.
- D. If the manufacturer's standard brochures and manuals are used to describe O&M procedures, modify or annotate these published documents to identify only the model or series of equipment installed on the project. Neatly cross out, eliminate or otherwise annotate extraneous material.
- E. Submittals that are not fully indexed and tabbed with sequentially numbered pages shall be returned without review.
- F. Provide two sets of CDs containing all AutoCAD as-built electrical and instrumentation drawings prepared for this project.

#### **PART 2 - PRODUCTS**

##### **2.01 GENERAL**

- A. Operation and maintenance data shall be provided in the form of an instructional manual for use by Owner's personnel.
- B. Format
  - 1. Size: 8½-inch by 11-inch. (except drawings)

2. Text
  - a. Manufacturer's printed data properly edited for project. Cross out all data that does not apply to the equipment to be furnished.
  - b. All documents shall be machine typed; hand-written documents are not acceptable. All documents shall be legible and original size, documents that cannot be read or have been reduced will be returned for correction.
3. Drawings
  - a. Provide drawings in a separate reinforced punched binder tab-bind in with text.
  - b. Drawings larger than 11-inch by 17-inch shall be placed in an 8½-inch by 11-inch envelopes bound in text.
  - c. Drawings shall be suitably identified on the Drawings binder.
  - d. Drawings shall be referenced in text.
4. Binders: Commercial quality, permanent, all white in color, three-ring, durable, cleanable plastic covers with inserts, insertable full height and width, front, back, and spine, with full-page sheet lifters. Size of binder shall be appropriate for the quantity of material it will contain.
5. Indexing: The manuals shall be fully indexed by use of side tabs.
6. All of these sets of O&M manuals shall be made up of "original" (no copies or reproductions) documents. No photo or fax copies are allowed of standard published manuals available from manufacturers.

## 2.02 CONTENTS OF MANUAL

### A. Presentation of Data

1. Include only those sheets that are pertinent to the specific product.
2. Annotate each sheet to:
  - a. Clearly identify the specific project or part installed.
  - b. Clearly identify the data applicable to the installation.
  - c. Cross-out references to inapplicable information.

### B. Drawings

1. Supplement product data with Drawings as necessary to clearly illustrate:
  - a. Relations of component parts of equipment and systems. Include individual parts list with exploded views for all equipment.
  - b. Control and flow diagrams.
2. Electrical/instrumentation coordinate drawings with information in project contract documents to assure correct illustration of completed installation.

### C. Written text as required to supplement product data for the particular installation:

1. Organize in a consistent format under separate headings for different procedures.
2. Provide a logical sequence of instructions for each procedure.

- D. Provide the index and information layout in the operation and maintenance manual for each unit of equipment, and system, including electrical, and electronic items as follows:
1. Cover sheet including the following:
    - a. Volume \_\_\_ of \_\_\_.
    - b. Operation and Maintenance Manual.
    - c. Project title.
    - d. Owner project number.
    - e. Manufacturer: Name, addresses, and telephone numbers of the manufacturer and the nearest representative of the manufacturer.
    - f. Date.
  2. Document Index: Neatly typewritten document index for each volume, arranged as indicated in shall be placed in Volume 1 itemizing all of the information included in the O&Ms and the corresponding volume location of that information.
  3. Equipment Record Sheet for Electrical/Instrumentation Equipment
    - a. Equipment record sheet for electrical/instrumentation equipment.
    - b. A complete list of items supplied, including serial numbers, ranges, options, and other pertinent data necessary for ordering replacement parts.
    - c. Name and location of nearest parts supplier for all equipment.
  4. Theory of Operation.
  5. Description: Provide description of units and components parts function, normal operating characteristics, and limiting conditions.
    - a. Include general descriptive bulletins, brochures, or catalog sheets to describe the equipment.
    - b. Performance curves, engineering data, and tests.
  6. Operating Instructions: Complete, detailed, written description of the sequence of operating sequence for all control system and operations in all modes. The description shall be specifically prepared for this work, and shall be fully referenced to control diagrams and system components:
    - a. Recommended step-by-step startup, adjustment, calibration and break-in operating instructions.
    - b. Routine and normal operating instructions. Include summer and winter operating instructions as applicable. Also include special operating instructions.
    - c. Recommended step-by-step regulation, control, starting, and shut-down instructions.
    - d. No photocopies are allowed of standard published manuals available from manufacturers.
    - e. Recommended step-by-step emergency instructions. Provide emergency procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include emergency shutdown instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance on emergency operations of all utility systems including valve locations and portions of systems controlled.

- f. Current and desired control settings.
- 7. Maintenance Instructions
  - a. Provide the following lubrication data.
    - 1) A table showing recommended lubricants for specific temperature ranges and applications;
    - 2) Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities; and
    - 3) A lubrication schedule showing service interval frequency.
  - b. Detailed service, maintenance and operation instructions for each item supplied. Preventative maintenance to include routine operation, alignment, adjusting, and checking. Include illustrations, assembly drawings, and diagrams required for maintenance. Preventative maintenance procedure and schedule for all equipment over a five-year cycle.
  - c. Corrective maintenance to include disassembly, repair, overhaul and re-assembly.
  - d. Schematic diagrams of all electronic devices shall be included. A complete parts list with stock numbers shall be provided on the components that make up the assembly.
  - e. Special maintenance requirements particular to this system shall be clearly defined, along with special calibration and test procedures.
  - f. No photocopies are allowed of standard published manuals available from manufacturers.
  - g. Include Maintenance Program data entry forms.
- 8. Shipping and Installation
  - a. Receiving and handling.
  - b. Long-term storage and short-term storage.
  - c. Complete step-by-step installation instructions of all components.
- 9. Safety Procedures
  - a. Manufacturer's safety procedures for operating and maintaining all equipment and materials used. List personnel hazards and safety precautions.
- 10. Parts Identification
  - a. Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number which will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies.

11. List of recommended spare parts:
  - a. Original manufacturer's parts list with manufacturer's current prices. Include complete nomenclature and commercial numbers of replaceable parts.
  - b. Predicted life of parts subject to warranty.
  - c. Items recommended to be stocked as spare parts.
  - d. Complete nomenclature and commercial number of all replaceable parts.
12. Testing Equipment and Special Tool Information
  - a. Provide information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.
13. Test Data
  - a. Include all test data and forms from factory and field testing.
14. Troubleshooting instructions.
15. Equipment catalogue sheets and submittals.
  - a. Include copy of all approved submittals.
16. Electrical and Instrumentation Drawings
  - a. Electrical & Instrumentation Drawings shall include as-built information for the project. As-built drawings shall be signed and stamped by an electrical engineer registered in the State of Oregon.
17. Complete software ladder logic printouts.
18. Record of all settings or parameters for all programmable devices.
19. At the end of the project these manuals shall be updated to show "as-built" or "as-installed" conditions.

### **PART 3 - EXECUTION (NOT USED)**

#### **END OF SECTION**

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## **SECTION 01785**

### **WARRANTIES AND BONDS**

#### **PART 1 - GENERAL**

##### **1.01 GUARANTEE OF WORK**

- A. The Contractor hereby agrees to make, at its own expense, all repairs or replacements necessitated by defects in materials or workmanship, supplied under terms of this Contract, and pay for any damage to other works resulting from such defects, which becomes evident within one (1) year after the date of acceptance of the project or the Substantial Completion date whichever is applicable or within such longer period of time as may be prescribed by law or by the terms of any applicable special guarantee required by the Contract Documents. The Contractor further assumes responsibility for a similar guarantee for all work and materials provided by subcontractors or manufacturers of packaged equipment components. The Contractor also agree to indemnify, defend, and hold the City of Cottage Grove harmless from liability of any kind arising from damage due to said defects.
- B. The Contractor shall execute and submit a completed Warranty Form in the format as located in Section 01999, and any portion of the Work possessed in accordance with the General Provisions. The Warranty Form shall be submitted prior to the Substantial Completion date or the final acceptance of the project or within five (5) days of the occupancy or use of a portion of the Work, whichever is applicable.
- C. The Contractor shall, upon the receipt of notice in writing from the Owner, promptly make all repairs arising out of defective materials, workmanship, or equipment. The Owner is hereby authorized to make such repairs, and the Contractor and its Surety shall be liable for the cost thereof, if ten (10) days after giving of such notice to the Contractor, the Contractor has failed to make or undertake the repairs with due diligence. In case of emergency, where in the opinion of the Owner delay could cause serious loss or damage, repairs may be made without notice being sent to the Contractor, and the expense in connection therewith shall be charged to the Contractor, and its Surety shall be liable for the cost thereof.
- D. Prior to the expiration of the Warranty period, the Owner reserves the right to hold a meeting and require the attendance of the Contractor. The purpose of the meeting is to review warranties, bonds and maintenance requirements and determine required repair or replacement of defective items.
- E. For the purpose of this paragraph, acceptance of the Work or a portion of the Work by the Owner, shall not extinguish any covenant or agreement on the part of the Contractor to be performed or fulfilled under this Contract which has not, in fact, been performed or fulfilled at the time of such acceptance. All covenants and agreements shall continue to be binding on the Contractor until they have been fulfilled.
- F. The Owner and the Contractor agree that warranty on the parts of the work possessed and used by the Owner in accordance with these Specifications, shall commence on the date that the Owner takes possession of such work and so notifies the Contractor in writing. The Owner and the Contractor further agree that such possession, and use of the work shall not be deemed as Substantial Completion or acceptance of any other part of the Work.
- G. If, after installation, the operation or use of the materials or equipment furnished under this Contract proves to be unsatisfactory to the Engineer or Owner, the Owner shall have the

right to operate and use such materials or equipment until it can, without damage to the Owner, be taken out of service for correction or replacement. Such period of use of the defective materials or equipment pending correction or replacement shall in no way decrease the guarantee period required for the acceptable corrected or replaced items of materials or equipment.

- H. Nothing in this Section shall be construed to limit, relieve or release the Contractor's, subcontractor's and equipment supplier's liability to the Owner for damages sustained as the result of latent defects in the equipment furnished caused by the negligence of the supplier's agents, employees or subcontractors. Stated in another manner, the warranty contained in this Section shall not amount to nor shall it be deemed to be a waiver by the Owner of any rights or remedies (or time limits in which to enforce such rights or remedies) it may have against the supplier of the equipment to be furnished under these Specifications for defective workmanship or defective materials under the laws of this State pertaining to acts of negligence.

**END OF SECTION**

## **SECTION 01786**

### **SPARE PARTS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Spare parts.
- B. Keys, special tools, and test equipment.
- C. For Pre-Purchased Equipment, follow the requirements defined in the Pre-Purchase Documents located in the Appendices.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 01600 – Materials and Equipment
  - 3. Section 01782 – Operation and Maintenance Information

##### **1.03 SUBMITTALS**

- A. Comply with Section 01330 for submittal requirements and procedures.
- B. Spare Parts Lists
  - 1. Prepare and submit a complete list of recommended spare parts for all equipment, appliances, and systems as specified in the various individual Sections of the Contract Specifications, as applicable.
  - 2. Include all spare parts as required to provide for the maintenance and repairs of all Contractor-furnished equipment and appliances for a period of two years after the date of the Acceptance of the Work.
  - 3. Organized in accordance with the Contract Specifications, by Section number and title.
    - a. Include the part's generic name or description, its trade name, Contractor's part number, manufacturer's name, manufacturer's part number, retail price, quantity, and correlation with the pertinent Contract Specifications, Contract Drawings, and Maintenance Manuals specified in Section 01782.
    - b. Spare parts shall be grouped by equipment category. Replacement parts common to more than one category shall be cross-referenced and indexed. Such common parts shall have only one part number.
- C. Maintenance Materials List
  - 1. Prepare and submit a complete list of maintenance materials as specified in the various individual Sections of the Contract Specifications.
  - 2. Organize in accordance with the Contract Specifications, by Section number and title. Include the quantities to be furnished.

3. Where maintenance materials are specified as a percentage of the materials installed, such percentages shall be translated to actual quantities of materials in the Maintenance Materials List.
- D. Keys, Special Tools, and Test Equipment List
1. Prepare and submit a complete list of the keys, special tools, and test equipment as specified in the various individual Sections of the Contract Specifications.
  2. The Keys, Special Tools, and Test Equipment List shall be organized in accordance with the Contract Specifications, by Section number and title.

#### 1.04 SPARE PARTS

- A. Requirements
1. Provide specific spare parts as specified in the individual Sections of the Contract Specifications.
  2. Spare parts shall be identical to the parts installed in the Work.
- B. Quantities: Provide quantities based on reliability requirements, replacement lead time, the Contractor's recommendations, and the following requirements:
1. Wear: Provide spare parts for components which may be expected to require regular replacement under normal maintenance schedules, such as mechanical parts subject to continuous operation.
  2. Consumability: Provide spare parts for components with a life-expectancy of less than 5 years.
  3. One-Time Limited Service: Provide spare parts which normally require replacement after performing their function one time, such as fuses.
  4. Long Lead Time: Provide spare parts for components which are not readily available from distributors, such as for custom-fabricated components.
  5. Exchange Assemblies: Provide assemblies which will be exchanged with malfunctioning units for installed equipment, and which must be inventoried as complete assemblies.

#### 1.05 MAINTENANCE MATERIALS

- A. Requirements
1. Provide maintenance materials as specified in the individual Sections of the Contract Specifications.
  2. Maintenance materials shall be identical to the materials installed in the Work.
- B. Quantities: Provide quantities of materials as specified in the individual Sections of the Contract Specifications.

#### 1.06 KEYS, SPECIAL TOOLS, AND TEST EQUIPMENT

- A. Requirements: Provide sufficient keys, special tools and wrenches, and special test equipment and gages as required to access, start, maintain, and repair all the installed equipment, appliances, systems, and assemblies.

- B. Quantities: Provide quantities of keys, special tools, and test equipment as specified in the individual Sections of the Contract Specifications.

#### 1.07 PACKAGING

- A. Comply with applicable requirements of Section 01600.
- B. All spare parts, maintenance materials, keys, special tools, and test equipment shall be securely packaged in boxes, with the boxes clearly labeled as to the contents.
- C. Such labeling shall include: location and description of the equipment and the item, complete listing of all items in the box, and the quantity of each item included in the box.

#### 1.08 DELIVERY

- A. Deliver spare parts, maintenance materials, keys, special tools, and test equipment to the warehouse location or locations specified in the Contract Specifications. Provide unloading service at the designated storage location for all delivered products.
- B. Prepare formal receipts for all such delivered products, and have them signed by the authorized Owner Representative at the location. A copy of all such receipts shall be submitted to the Construction Manager for information and record.

#### 1.09 STORAGE

- A. Spare parts, maintenance materials, keys, special tools, and test equipment may be stored temporarily at the site of the work in suitable storage facilities until time to deliver these products to the locations designated in the Contract Specifications. Any such storage shall comply with the requirements specified in Section 01600.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

### **END OF SECTION**

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## **SECTION 01810**

### **FACILITY START-UP AND COMMISSIONING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Project requirements for Start-up and Commissioning

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01600 – Materials and Equipment
  - 2. Section 01820 – Training

##### **1.03 DEFINITIONS**

- A. Start-up: The initial operation of the facility and/or plant, utilizing wastewater and related substances (sludge, methane, scum), or other media which the facility has been designed to process.
- B. Commissioning: A confirmation that equipment, systems and facilities operate in accordance with the design intent and satisfy the detailed requirements of the technical specifications. The duration of the commissioning period shall be not less than 7 consecutive days.

##### **1.04 SERVICES OF MANUFACTURER**

- A. Manufacturer's services for inspection, physical checkout, field adjustment, field testing, and start-up shall comply with the requirements of this Section, the requirements of the particular equipment or product technical specifications contained in Divisions 2 through 17, and the requirements of Section 01600.
- B. Manufacturer's services for training and instruction of the Owner's personnel shall comply with the requirements of the particular equipment or product technical specifications contained in Divisions 2 through 16 and Section 01820.

##### **1.05 ROLES AND RESPONSIBILITIES**

- A. Contractor's Responsibilities
  - 1. Review specific start-up plan(s) provided by the Engineer in order to:
    - a. Schedule and coordinate with the Engineer for start-up of equipment and systems.
    - b. Review procedures for facility start-up.
  - 2. Review preliminary punch list items with the Engineer 15 days prior to the scheduled start-up; and complete, correct, or resolve at the option of the Engineer, any items which impact or interfere with the facility start-up.
  - 3. Attend meetings related to the review of start-up plan(s).

4. Clarify submittals, testing requirements, schedules, or other items related to the start-up of the equipment and facilities specified and indicated in the Contract Documents.
  5. Provide all start-up materials and operating supplies for 30 operating days. Supplies include lubricants, chemicals, gases, and specialized fluids to maintain operation for 30 days.
  6. Provide Manufacturer's authorized representatives as required to supervise placing equipment or systems in operation and to provide guidance during the start-up period.
  7. Provide to the Engineer a list of 24 hour, "on call" representative supervisory persons who will monitor the facility start-up, and serve as a liaison for the Engineer.
  8. Provide the necessary craft or labor assistance full time during the day shift and as required at other times in the event of an emergency requiring immediate attention. An emergency is defined as a failure which precludes the further operation of a critical segment of the Work. The response time shall be not less than four hours from the time of notification.
  9. Correct all failures or equipment problems identified during start-up. Repairs deemed the responsibility of the Contractor shall be made at no additional cost to the Owner.
- B. The responsibilities of the Owner's O&M staff during the 7-day facility start-up period include the following:
1. Provide staff to operate equipment, systems, and facilities requiring start-up.
  2. Provide all utilities including power, natural gas, and water.
- C. The Engineer's responsibilities for the facility start-up period include the following:
1. Coordinate the Contractor's start-up activities with plant operations staff.
  2. Verify the results of performance tests and any retesting.
  3. Direct the Contractor to repair defective workmanship, materials, and equipment.

#### 1.06 COMMISSIONING

- A. The Owner's Operations and Maintenance staff will initiate the commissioning period and will operate the facility throughout the duration of the commissioning period. All equipment must operate properly and continuously 24 hours per day for the test period. If any item malfunctions during the test, the item shall be repaired and the test restarted at day zero with no credit given for the operating time before the malfunction.
- B. The purpose of this 7-day operational demonstration is to:
1. Provide the environment by which the Owner's O&M staff can place equipment and systems into service.
  2. Expose flaws or defects in workmanship, equipment, or materials, not previously discovered that are the responsibility of the Contractor to repair, correct, modify, or replace prior to Final Acceptance.



**PART 2 - PRODUCTS (NOT USED)**

**PART 3 - EXECUTION (NOT USED)**

**END OF SECTION**

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## **SECTION 01820**

### **TRAINING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Requirements for training the Owner's personnel, by persons retained by the Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this Contract.
- B. Coordinate with the equipment suppliers for all training activities and provide additional labor, services, and materials as required to complete training.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals

##### **1.03 TRAINING SESSIONS**

- A. Where required by the detailed specifications, provide on-the-job training of the Owner's personnel, which will include plant operations personnel, mechanics, electricians, and electronics technicians.
- B. The training sessions shall be conducted by qualified, experienced (2 years minimum), manufacturer's factory-trained representatives (not sales representatives) of the various equipment manufacturers.
- C. Include instruction in both equipment operation and preventive maintenance.
- D. Field training sessions shall take place at the project site. Classroom training facility will be provided at the site by the Owner.

##### **1.04 TIMING OF TRAINING SESSIONS**

- A. Conduct training sessions in conjunction with the operational testing and commissioning periods.
- B. Operation and maintenance manuals shall be approved and ready for distribution to the Owner's personnel at least 30 days prior to the date scheduled for the individual training session.

##### **1.05 SUBMITTALS**

- A. The following information shall constitute the Contractor's training plan and be submitted to the Engineer in accordance with the provisions of Section 01330.
  - 1. Lesson plans for each training session to be conducted by the Contractor's representatives. In addition, training manuals, handouts, visual aids, and other reference materials shall be included.
  - 2. Date, time, and subject of each training session and identity and qualifications of individuals to be conducting the training.

3. Training schedule. Concurrent classes will not be allowed.
- B. Due to phased testing and start-up activities, Contractor may prepare separate submittals for individual equipment items and systems. The materials shall be reviewed and accepted by the Engineer no later than 3 weeks prior to delivery of the training.

## **PART 2 - PRODUCTS**

### **2.01 LESSON PLANS**

- A. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session.
- B. Each lesson plan shall contain a time allocation for each subject.
- C. Furnish ten copies of the training manuals, handouts, and reference materials and one copy of necessary visual aids at least 1 week prior to each training session. These materials shall remain the property of the Owner and shall be suitably bound for proper organization and easy reproduction.

### **2.02 FORMAT AND CONTENT**

- A. Each training session shall be comprised of time spent both in the classroom and at the specific location of the subject equipment or system.

### **2.03 VIDEO RECORDING**

- A. The City may record, or retain the services of a commercial video taping service to record, each training session. After taping, the material may be edited and supplemented with professionally produced graphics to provide a permanent record.

## **PART 3 - EXECUTION**

### **3.01 SCHEDULING TRAINING SESSIONS**

- A. Classes shall be scheduled such that classroom sessions are interspersed with field instruction in logical sequence. Consolidate short training sessions into combined sessions so that staff time is more efficiently used. The minimum combined session length should be 1.5 to 2 hours. The maximum single or combined session length shall be 4 hours. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 4 hours of classes scheduled for any one day. Contractor shall provide two training sessions on each system, piece of equipment, or "topic".
- B. No training sessions shall be scheduled for Mondays or Fridays. The Contractor shall coordinate the scheduling of training sessions with the operations superintendent.
- C. The following services shall be provided for each item of equipment or system. Additional services shall be provided, where specifically required in individual specification sections.
  - a. At a minimum, classroom equipment training for operations personnel will include:
  - b. Using slides and drawings, discuss the equipment's specific location in the plant and an operational overview.
  - c. Purpose and plant function of the equipment.
  - d. A working knowledge of the operating theory of the equipment.

- e. Start-up, shutdown, normal operation, and emergency operating procedures, including a discussion on system integration and electrical interlocks, if any.
  - f. Identify and discuss safety items and procedures.
  - g. Routine preventative maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.
  - h. Operator detection, without test instruments, of specific equipment trouble symptoms.
  - i. Required equipment exercise procedures and intervals.
  - j. Routine disassembly and assembly of equipment if applicable (as judged by the City on a case-by-case basis) for purposes such as operator inspection of equipment.
2. At a minimum, hands-on equipment training for operations personnel will include:
- a. Identify location of equipment and review the purpose.
  - b. Identifying piping and flow options.
  - c. Identifying valves and their purpose.
  - d. Identifying instrumentation:
    - 1) Location of primary element.
    - 2) Location of instrument readout.
    - 3) Discuss purpose, basic operation, and information interpretation.
  - e. Discuss, demonstrate, and perform standard operating procedures and round checks.
  - f. Discuss and perform the preventative maintenance activities.
  - g. Discuss and perform start-up and shutdown procedures.
  - h. Perform the required equipment exercise procedures.
  - i. Perform routine disassembly and assembly of equipment if applicable.
  - j. Identify and review safety items and perform safety procedures, if feasible.
3. Classroom equipment training for the maintenance and repair personnel will include:
- a. Theory of operation.
  - b. Description and function of equipment.
  - c. Start-up and shutdown procedures.
  - d. Normal and major repair procedures.
  - e. Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the “pass” and “no pass” test instrument readings.
  - f. Routine and long-term calibration procedures.
  - g. Safety procedures.
  - h. Preventive maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.

4. Hands-on equipment training for maintenance and repair personnel shall include:
  - a. Locate and identify equipment components.
  - b. Review the equipment function and theory of operation.
  - c. Review normal repair procedures.
  - d. Perform start-up and shutdown procedures.
  - e. Review and perform the safety procedures.
  - f. Perform City approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.
  - g. Review and use equipment manufacturers' manuals in the hands-on training.

**END OF SECTION**

## **SECTION 01825**

### **EQUIPMENT AND SYSTEM TESTING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Requirements for the Contractor's testing of mechanical, electrical, and instrumentation equipment and systems provided under this Contract.
- B. The requirements contained in this Section supplement, but do not supersede, specific testing requirements found elsewhere in the Contract Documents.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 01999 – Reference Forms

##### **1.03 COORDINATION**

- A. Coordinate with the equipment suppliers for functional and performance testing and facility startup. Minimum levels of on-site installation and testing assistance required of the equipment suppliers is described in separate Sections.
- B. Coordinate the activities of subcontractors and equipment suppliers to implement the requirements of this Section.

##### **1.04 SUBMITTALS**

- A. Prepare and submit in accordance with Section 01330.
- B. Independent Testing Labs: When testing by an independent laboratory is specified, provide credentials and certifications to demonstrate capabilities.
- C. Test Instruments Calibration: Certification that test instruments used in the testing procedure have been calibrated to an acceptable and recognized standard.
- D. Testing Schedule: For each piece of equipment or system, provide a testing schedule and updates as appropriate. Submit at least 20 working days prior to the scheduled start of testing. Confirm the test schedule, or provide an updated schedule 4 days prior to the start of testing.
- E. Testing Plan: Describe step by step procedure that will be utilized to systematically test equipment and systems.
- F. Test Results:
  - 1. Factory Test Results: Results of equipment tests performed by the equipment supplier at the point of manufacture and prior to shipping the equipment to the site.
  - 2. Results of the Pre-Operational Test.
  - 3. Results of the Functional Test.
  - 4. Results of the Operational and Performance Tests.

- G. Testing Form
  - 1. Section 01999 contains a sample Instrumentation Data and Calibration Test Form showing the format and level of detail required for the documentation forms.
- H. Manufacturer's Field Certification
  - 1. Submit a Manufacturer's Installation Certification Form (Section 01999) after the manufacturer's Field Representative has completed the specified field services and testing. Submit the certification prior to Manufacturer's Representative leaving the plant site.

#### 1.05 DOCUMENTATION REQUIREMENTS

- A. Develop and implement a records keeping system to document compliance with the requirements of this Section.
- B. Document date of test, equipment number or system name, nature of test (performance or operational), test objectives, test results and test instruments used during the test. Provide signature spaces for the Engineer and the Contractor.

#### 1.06 TEST PLANS

- A. Develop test plans in cooperation with the equipment suppliers detailing the coordinated, systematic testing of each item of equipment and system provided under this Contract.
- B. Make test plans specific to the item of equipment or system to be tested. Identify by specific equipment or tag number each device or control station to be manipulated, observed or tested during the test procedure and the specific results to be observed or obtained.
- C. Identify the responsibility of subcontractors and suppliers who will participate in the tests and list the names of manufacturers' representatives to be present during the duration of the test.
- D. Provide step-by-step procedures for testing control and electrical circuits to affirm that the circuit is properly identified and connected to the proper device.
- E. Undertake performance tests in a manner that will duplicate the actual operating conditions that will be encountered.

#### 1.07 TESTING SCHEDULE

- A. Prepare a testing schedule setting forth the sequence contemplated for performing the test work. Identify the contemplated start date, duration of the test and completion of each test.

#### 1.08 TEST RESULTS

- A. Test results shall be within the tolerances set forth in the detailed specification sections of the Contract Documents. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice.
- B. Retesting: If any portion of the work should fail to fulfill the Contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion, together with all other portions of the work as are affected thereby, shall be repeated within reasonable time and in accordance with the specified conditions.



## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. The objective of the testing program is to demonstrate, to the Engineer's complete satisfaction, that the systems and equipment provided under this Contract meet the specified performance requirements.
- B. Testing program also provides a base-line operating condition for the Owner to use in a preventative maintenance program.
- C. Testing sequence consists of Pre-Operational Checkout, Functional Tests, Performance Testing and Operational Testing. These tests are required regardless of whether Factory Tests were conducted on the same piece of equipment or system.
- D. Each item of mechanical, electrical, and instrumentation equipment installed under this Contract shall be tested by the Contractor to demonstrate compliance with the performance requirements of this project.
- E. Provide labor, outside services, materials, test equipment and other items required to complete the specified testing and startup requirements. Furnish power, water chemicals, fuel, oil, grease and other materials needed to conduct the specified tests.
- F. Install temporary valves, gauges, piping and other materials required to conduct the specified tests.

### **3.02 PRE-OPERATIONAL CHECKOUT**

- A. Pre-Operational Checkout shall be undertaken by the manufacturer's field representative.
- B. Pre-Operational Checkout includes basic checks of the equipment installation prior to starting the equipment to determine if the equipment and related components have been correctly installed and is ready for starting.
- C. Pre-Operational Checkout includes the following:
  - 1. Alignment of equipment, shafts and shaft couplings, drives, belts and pulleys.
  - 2. Filling and checking lubrication reservoirs.
  - 3. Checking shaft seals, packing and seal lubrication system.
  - 4. Manufacturer's recommendations for pre-start preparation.
  - 5. Proper motor rotation
  - 6. Circuit continuity testing, electrical testing, and instrumentation and control system testing in accordance with the requirements of Division 16.
  - 7. Demonstrate operational controls function as intended.
  - 8. Calibration and adjustment of electrical and instrumentation devices.
- D. Verify tanks, pipes, conduits, vessels and equipment are clean and free of debris that may interfere with the testing or operation of the equipment. Remove debris prior to start of testing.
- E. Following completion of the Pre-Operational Checkout, the manufacturer's field representative shall complete and sign a field certification form and submit to the Engineer.

### 3.03 FUNCTIONAL TESTS

- A. After successful completion of the Pre-Operational Checkout, start individual items of equipment and systems and operate under simulated operating conditions to determine as nearly as possible whether the equipment and systems meet the requirements of these specifications.
- B. Operate the equipment for a sufficient period of time to determine machine operating and characteristics, including noise, temperatures and vibration; to observe and document performance characteristics; and to permit initial adjustment of operating controls.
- C. Obtain baseline operating data on all equipment with motors greater than 10 horsepower to include amperage draw, bearing temperatures, and vibration as required. This baseline data will be collected for the Owner to enter in their preventive maintenance system.
- D. Post-Test Inspection: When Functional Tests have been completed, recheck equipment for proper alignment, unacceptably loose connections, unusual movement, or other indications of improper operating characteristics. Correct any deficiencies to the satisfaction of the Engineer.
- E. Machines or devices which exhibit unusual or unacceptable operating characteristics shall be disassembled and inspected. Repair any defects found during the course of the inspection and identify and correct the cause of such defect. Replace specific parts, or the entire equipment item, to the complete satisfaction of the Engineer at no cost to the Owner.

### 3.04 OPERATIONAL AND PERFORMANCE TESTS

- A. After successfully completing functional tests, conduct an operational test of each system to verify correct operation. During the operational test, conduct performance testing to verify that the system complies with the performance requirements contained in the individual equipment specifications.
- B. Owner's operating personnel will fill process units and process systems with water and other process fluids to allow the Contractor to conduct the operational tests.
- C. Upon completion of the filling operations, operate all parts of each system for a continuous, uninterrupted period of not less than 8 hours. During this period, the Contractor shall undertake performance testing and shall monitor the characteristics of each machine according to manufacturer information and specifications and report any unusual conditions to the Engineer.
- D. Undertake performance tests of mechanical, electrical, HVAC, and instrumentation equipment and systems to demonstrate and confirm compliance with the performance requirements specified in the individual equipment specifications.
- E. Should the operational testing be halted for any reason related to the facilities constructed or the equipment furnished under this Contract, the operational testing program shall be repeated until the specified continuous period has been accomplished without interruption.
- F. Following successful completion of the Operational Test, commissioning of the system may begin.

### **END OF SECTION**

## **SECTION 01890**

### **RESTORATION OF IMPROVEMENTS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Restoration of work areas after installation and construction of new facilities.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 02953 – Asphalt Concrete Pavement Replacement

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION**

##### **3.01 STRUCTURES**

- A. Take precautions to protect the integrity and usefulness of existing facilities.
- B. If necessary, remove existing structures including curbs, gutters, pipelines, and utility poles, as necessary for the performance of the work.
  - 1. Repair existing structures that are damaged as a result of the Work under this contract
  - 2. Rebuild or replace the structures in as good a condition as originally found.

##### **3.02 ROADS AND STREETS**

- A. Asphalt pavement that has been removed, broken, or damaged, or in which the ground has caved or settled during the work under this contract, shall be brought to original grade and section and resurfaced.
- B. Before resurfacing material is placed, sawcut edges of pavement to provide clean solid vertical faces.
- C. Complete pavement repair in accordance with Section 02953 and in accordance with the requirements of the affected agencies and parties.

##### **3.03 CULTIVATED AREAS AND OTHER SURFACE IMPROVEMENTS**

- A. Restore cultivated or planted areas and other surface improvements damaged by construction as nearly as possible to their original condition.
- B. Repair existing guard posts, barricades, and fences that are damaged.
- C. Replace damaged plantings with new plantings of the same type or as acceptable to the Owner

##### **3.04 PROTECTION OF EXISTING INSTALLATIONS**

- A. Immediately repair or replace existing equipment, controls, structures, or facilities which are damaged as part of the Work.

- B. Take measures that are necessary to ensure that construction debris and materials are kept out of the wastewater system.

**END OF SECTION**

## SECTION 01999

### REFERENCE FORMS

The forms listed below and included in this section are referenced from other sections of the project manual. Contractor may submit equivalent forms for Owner's approval prior to use. If Owner does not approve substitute form, Contractor must use forms found in this Section. Owner will provide Contractor electronic files of prescribed forms upon request.

Referenced In Section	Title of Form
09900, 11060, 11338	Extended Warranty
01825, 11338	Instrumentation Data and Calibration Record Test Form
01825, 11000, 11338	Manufacturer's Installation Certification Form
11338,	Manufacturer's Instruction Certification Form
11338,	Manufacturer's Representative Service Report
11060, 11338	Motor Data
01330, 11338	Operating and Maintenance Information Transmittal
15996	Pipe Test Record
01330, 11338	Proposed "Or Equal" Substitution Transmittal
01340	Request for Information
01330, 11338	Submittal Transmittal
01140,	System Outage Request
11338	Unit Responsibility Certificate

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**EXTENDED WARRANTY FORM**  
(For Equipment, Material, Process)

Extended Warranty For: Product Name

Specification Section No. \_\_\_\_\_

Product Manufacturer \_\_\_\_\_

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

Location: \_\_\_\_\_

We hereby guarantee the Product Name that we have constructed for a period of # of Years (#) year(s), as specified in the Section noted above, from Date, the date of acceptance of the work/substantial completion and the assumption of occupancy and beneficial use by the Name of Owner.

The following are excluded from the provisions of this warranty:

We agree that if any of the equipment, material, or process designated for Product Name should fail due to any reason other than improper maintenance or improper operation, or should any portion of the work fail to fulfill any of the requirements of the Specifications, we will, within ten days after written notice of such defects, commence to repair or replace the same together with any other work which may be damaged or displaced in so doing.

In the event of our failure to comply with the above mentioned conditions within a reasonable time after being notified, or should exigent circumstances require repairs or replacements to be made before we can be notified or respond to notification, we do hereby authorize the Name of Owner to proceed to have the defect repaired and made good at our expense, and we will pay the cost therefor upon demand.

The warranty provided herein shall not be in lieu of, but shall be in addition to any warranties or other obligations otherwise imposed by the Contract Documents and by law.

Manufacturer: _____	Contractor: _____
Signed: _____	Signed: _____
Title: _____	Title: _____
Date: _____	Date: _____
Phone: _____	Phone: _____
E-mail: _____	E-mail: _____

# INSTRUMENTATION DATA AND CALIBRATION RECORD TEST FORM

Component Description \_\_\_\_\_

Component Tag Name \_\_\_\_\_

Manufacturer \_\_\_\_\_ Location \_\_\_\_\_  
Name \_\_\_\_\_ Site \_\_\_\_\_  
Model \_\_\_\_\_  
Serial # \_\_\_\_\_ Equip \_\_\_\_\_

	Range	Unit	General Notes		
Indicator Range			1) Attach Calibration Curves for dp Flowmeters		
Input Range			2) Include mounting elevations for level Instruments		
Output Range			3) All entries within solid box to be typed in prior to start of test		
Designed Calibration			Measured Calibration		
Input Signal	Output	Eng. Value	Input	Output	Comments

Notes:

Tested by \_\_\_\_\_ (print name)      Witnessed by \_\_\_\_\_ (print name)

Signature \_\_\_\_\_      Signature \_\_\_\_\_  
Date \_\_\_\_\_      Date \_\_\_\_\_



MANUFACTURER'S INSTALLATION CERTIFICATION FORM

Contract No: \_\_\_\_\_ Specification Section: \_\_\_\_\_

Equipment Name \_\_\_\_\_

Contractor: \_\_\_\_\_

Manufacturer of Equipment Item: \_\_\_\_\_

*The undersigned manufacturer of the equipment item described above hereby certifies that he has checked the installation of the equipment and that the equipment, as specified in the project manual, has been provided in accordance with the manufacturer's recommendations and that the trial operation of the equipment item has been satisfactory.*

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Date

\_\_\_\_\_  
Manufacturer

\_\_\_\_\_  
Signature of  
Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Signature of  
Authorized Representative

## MANUFACTURER'S INSTRUCTION CERTIFICATION FORM

Contract No: \_\_\_\_\_ Specification Section: \_\_\_\_\_

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

Contractor: \_\_\_\_\_

Manufacturer of Equipment Item: \_\_\_\_\_

*The undersigned manufacturer certifies that a service engineer has instructed the owner's staff in the proper maintenance and operation of the equipment designated herein.*

### **Operations Check List** (check appropriate spaces)

Start-up procedure reviewed ☐

Shutdown procedure reviewed ☐

Normal operation procedure reviewed ☐

Others: ☐

\_\_\_\_\_ ☐

\_\_\_\_\_ ☐

### **Maintenance Check List** (check appropriate spaces)

Described normal oil changes (frequency) ☐

Described special tools required ☐

Described normal items to be reviewed for wear ☐

Described preventive maintenance instructions ☐

Described greasing frequency ☐

Others ☐

\_\_\_\_\_ ☐

\_\_\_\_\_ ☐

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

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Authorized Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Owner's Representative

\_\_\_\_\_  
Date

\_\_\_\_\_  
Signature of Contractor's Representative

## MANUFACTURER'S REPRESENTATIVE SERVICE REPORT

Owner: \_\_\_\_\_ File No. \_\_\_\_\_

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

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

- This form should be completed and returned by the manufacturer's representative prior to leaving the site.

Manufacturer: \_\_\_\_\_ MRSR No. \_\_\_\_\_

Supplier: \_\_\_\_\_ Contract/P.O. No. \_\_\_\_\_

Manufacturer's Representative \_\_\_\_\_  
Company

Equipment/Material: \_\_\_\_\_

Work performed and tests made on equipment:

Factory errors corrected:

Field errors corrected:

The above equipment \_\_\_\_ is \_\_\_\_ is not ready to be placed in operation.

Remarks:

Arrival onsite \_\_\_\_\_ Department from Site \_\_\_\_\_  
Date Time AM PM Date Time AM PM

Actual total duration onsite was \_\_\_\_\_ hours for period covered by this report.

Manufacturer's Representative \_\_\_\_\_  
Signature Date

Address: \_\_\_\_\_  
Phone No.

Report Received By: \_\_\_\_\_  
Signature Date

Distribution: \_\_\_\_\_

## MOTOR DATA FORM

Equipment Name: \_\_\_\_\_ Equipment Number: \_\_\_\_\_

Site Location: \_\_\_\_\_

### Nameplate Markings

Mfr \_\_\_\_\_ Mfr Model \_\_\_\_\_ Frame \_\_\_\_\_ HP \_\_\_\_\_

Volts \_\_\_\_\_ Phase \_\_\_\_\_ RPM \_\_\_\_\_ Service Factor \_\_\_\_\_

FLA \_\_\_\_\_ LRA \_\_\_\_\_ Freq \_\_\_\_\_ Amb temp rating \_\_\_\_\_ degrees C

Time rating \_\_\_\_\_ Design letter \_\_\_\_\_

(NEMA MG1-10.35)

(NEMA MG-1.16)

KVA code letter \_\_\_\_\_ Insulation class \_\_\_\_\_

The following information is required for explosionproof motors only:

A. Approved by UL for installation in Class \_\_\_\_\_, Div \_\_\_\_\_

B. UL frame temperature code \_\_\_\_\_, Group \_\_\_\_\_ Atmosphere

(NEC Tables 500-2 and 500-2(b))

The following information is required for high efficiency motors only:

A. Guaranteed minimum efficiency at full load or NEMA efficiency index

(NEMA MG1-12.53b)

B. Nameplate or nominal efficiency \_\_\_\_\_

### Data Not Necessarily Marked on Nameplate

Type of enclosure \_\_\_\_\_ Enclosure material \_\_\_\_\_

Temp rise \_\_\_\_\_ degrees C (NEMA MG1-12.41,42)

Space heater included? \_\_\_\_\_ Yes \_\_\_\_\_ No, if Yes \_\_\_\_\_ watts \_\_\_\_\_ volts

Type of motor winding overtemperature protection, if specified:

Use the space below to provide additional information on other motor modifications, if specified:

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## OPERATING AND MAINTENANCE INFORMATION TRANSMITTAL

**Submittal Description:** \_\_\_\_\_

<b>Submittal No.</b>	<b># Copies:</b>
<input type="checkbox"/> 1st Submission	<input type="checkbox"/> Re-Submittal
Spec Section	

	Routing	Date Sent	Date Received
Owner:	Contractor/CM		
Project:	CM/Design Consultant		
	Design Consultant/CM		
Contractor:	CM/Contractor		

Supplier Name:	Supplier Review		Design Consultant Review	
Checklist	Satisfactory	N/A	Accept	Deficient
1. Table of Contents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Equipment Record Forms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Supplier/Vendor Contact Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Safety Precautions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Operator Pre-Start	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Start-up, Shutdown/Post-Shutdown Procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Normal Operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Emergency Operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Operator Service Requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Environmental Conditions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Lubrication Data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Preventative Maintenance Plan/Schedule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Troubleshooting Guide/Diagnostic Techniques	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
14. Wiring Diagrams and Control Diagrams	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. Maintenance and Repair Procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. Removal and Replacement Procedures	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Spare Parts and Supply List	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Corrective Maintenance Man-hours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Parts Identification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. Warranty Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. Personnel Training Requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. Testing Equipment and Special Tool Information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

<b>Remarks:</b>	
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 (Contractor's Signature)

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 (Supplier's Signature)

## PIPE TEST RECORD

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

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

Contractor: \_\_\_\_\_

Pipeline Size & Name	Pipe Type	Pipe Location/Description
(SL), SN, IA, etc.)	(DI, PVC, Steel, Copper, etc.)	(Attach sketch if needed)
<b>Section Tested:</b> From: _____ To: _____	<b>First Test</b> <input type="checkbox"/> <b>Or</b> <b>Re-Test</b> <input type="checkbox"/>	<b>Length of Pipe Tested:</b> _____ Ft.

Test Specifications	Actual Test Results
Type of Test: _____	Start pressure: _____
Specified Test Pressure: _____	End Pressure: _____
Duration: _____	Start time      Stop time      Duration _____
Allowable loss: _____	Actual loss: _____

Comments:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Test Passes	<input type="checkbox"/>
Test Fails	<input type="checkbox"/>

Tested By: \_\_\_\_\_  
Contractor

Test Witnessed By: \_\_\_\_\_  
Construction Inspector

## PROPOSED "OR EQUAL" SUBSTITUTION SUBMITTAL TRANSMITTAL

### Proposed "Or Equal Substitution Submittal Description

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Priority Level: ☐ Low ☐ Medium ☐ High ☐ On Critical Path

<b>Submittal No.</b>	
<input type="checkbox"/> 1st Submission	<input type="checkbox"/> Re-Submittal
Spec Section	
Dwg/Detail No.	

Owner:	<b>Routing</b>	<b>Date Sent</b>	<b>Date Received</b>
Project Name:	Contractor/CM		
	CM/Design Consultant		
Contractor:	Design Consultant/CM		
	CM/Contractor		

### Proposed "Or Equal" Substitution Item or Service

- A. When the first specified item is followed by a second maker's name and "or equal," the Contractor may submit Proposed Equivalent items for the Engineer's review. Proposed "Or Equal" Substitution items that are in the Engineer's judgment equal to the first specified item in quality, utility, and appearance, will be Favorably Reviewed. Where a product description and first maker's name is followed by "or equal" with no second maker's name, it means the Engineer knows of no equivalent product and the Contractor may submit Proposed Equivalent products by other makers for review. Where the term "or equal" is omitted, it means that the named item is required to meet the Owner's needs; no products or makers other than those specified will be considered.
- B. This request shall include adequate technical information to fully describe the function and quality of the item. Submittals of Proposed "Or Equal" Substitution items that are not made within thirty (30) calendar days of the Notice to Proceed date will be rejected unless the Owner has agreed in writing to a later submittal date and the Contractor agrees to comply with all conditions of the Owner for the late submittal. If the Contractor's second attempt to obtain Favorable Review of a Proposed "Or Equal" Substitution item is unsuccessful, the Contractor shall submit the first specified item.
- C. Inclusion of a second maker's name indicates the maker is acceptable but does not necessarily indicate the maker offers a standard product equal to the first specified item. Items by the second named maker are subject to the same conditions of review and compatibility as other Proposed "Or Equal" Substitution items. Inclusion of a maker's name and/or model number after a specification description is not a representation that the maker will furnish an item meeting the Contract requirements at bid time or at time of need. It is the Contractor's sole responsibility to furnish items meeting the Contract requirements.
- D. The Engineer's review of Proposed "Or Equal" Substitution items is based solely on information provided by the Contractor and on the Contractor's warranty that the proposed item is equal in quality, utility, function and appearance to the first specified item. Favorable Review of a Proposed "Or Equal" Substitution item has the same meaning and is subject to the same limitations that apply to the Favorable Review of Product Data and Shop Drawings described in the Contract Documents.
- E. Submit with proposal:
1. Description of item being proposed including the Manufacturer's model or product number.
  2. Manufacturer's representation that the proposed "or equal" substitution item or service is equal to or superior to specified item in all respects.
  3. Manufacturer's product data.
  4. Information about several recent similar installations, including project name, owner's name, address, telephone number, and name of knowledgeable person to contact for information on performance of the product.

5. Whether a reduction in the Contract Price is being proposed. If so, provide a detailed cost breakdown substantiating the cost reduction. Consideration should be given to all extra costs and expenses necessary to make the proposed “or equal” substitution meet or exceed the all requirements found in the Contract Documents.
6. Whether a reduction in the Contract Time is being proposed. If so, provide schedule analysis substantiating the reduction in contract time and assumptions made in the schedule analysis.
7. Explain all known differences between the product specified and the Proposed “Or Equal” Substitution. Explanation to consider such items as:
  - a) Does the substitution affect dimensions shown on Drawings?
  - b) Are the manufacturer's guarantees and warranties on the proposed substitution items identical to those on the specified items? If there are differences, please specify each and every difference in detail.
  - c) Does the proposed “or equal” substitution impact other contractors, trades or suppliers?
  - d) Is the proposed “or equal” substitution compatible with all other interrelated equipment, materials and products?
  - e) Any differences in Operations and Maintenance costs?
  - f) Any differences in available factory authorized repair centers with regards to response times and geographic location?
  - g) Will use of proposed “or equal” substitution be subject to any license fee or royalty?
  - h) Are there any color or pattern differences? If so, provide color and pattern samples?

The undersigned hereby:

1. Certifies that he/she has thoroughly investigated the Proposed “Or Equal” Substitution item or service and has determined that the function/utility, appearance and quality of the Proposed “Or Equal” Substitution item or service are equivalent or superior to those of the specified item;
2. Certifies that the Proposed “Or Equal” Substitution item or service is compatible with all interrelated equipment, materials, products and services unless otherwise explained in specific detail in this submittal;
3. Agrees to coordinate installation and make all other changes that may be required for Work to be complete in all respects at no additional cost to the Owner;
4. Waives all claims for additional costs and contract time due to late ordering of the specified products or services caused by requests for “Or Equal” Substitutions that are subsequently rejected by the Engineer;
5. Represents and warrants that the Contractor is solely responsible for any extra cost or expense necessary to make the Proposed “Or Equal” Substitution item or service fully equivalent to and compatible with the Contract Documents and will meet or exceed the Engineer’s design intent;
6. Agrees to compensate the Owner for all additional redesign costs associated with the Proposed “Or Equal” Substitution item or service and the cost of the Engineer’s review of the Proposed “Or Equal” Substitution item or service;
7. Waives all claims for additional costs and contract time which may subsequently become apparent; and
8. Agrees to comply with all additional requirements imposed by the Owner and Engineer should the Proposed “Or Equal” Substitution item or service is approved.

Submitted by: \_\_\_\_\_

Contractor: \_\_\_\_\_

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

Signature: \_\_\_\_\_ Title: \_\_\_\_\_

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



REQUEST FOR INFORMATION

RFI No.: XXX

Owner: \_\_\_\_\_

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

Contractor: \_\_\_\_\_ Engineer \_\_\_\_\_

RFI Generated by:    ☐ Contractor    ☐ CM    ☐ Other

Priority Level:        ☐ Low            ☐ High        ☐ On Critical Path

Is there a Cost Impact associated with this RFI?    ☐ Yes        ☐ No        ☐ Possibly

Is there a Time Impact associated with this RFI?    ☐ Yes        ☐ No        ☐ Possibly

**RFI Title:** \_\_\_\_\_

Reference: Spec: \_\_\_\_\_ Sheet: \_\_\_\_\_

**Requested Information:**

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

**Response:**

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

## SUBMITTAL TRANSMITTAL

Submittal Description \_\_\_\_\_

Priority Level: ☐ Low ☐ Medium ☐ High ☐ On Critical Path

Submittal No.	
<input type="checkbox"/> 1st Submission	<input type="checkbox"/> Re-Submittal
Spec Section	
Dwg/Detail No.	

Owner:	Routing	Date Sent	Date Received
Project Name:	Contractor/CM		
	CM/Design Consultant		
Contractor:	Design Consultant/CM		
	CM/Contractor		

We are sending you: ☐ Attached ☐ Under separate cover via \_\_\_\_\_  
☐ Submittals for review and comment  
☐ Product Data for information only \_\_\_\_\_

No. Copies	Description	Manufacturer	Reviewer Action	Reviewer Initials

<p>The Action Designated Above is in Accordance with the Following Legend:</p> <p>A – No Exceptions Taken B – Make Corrections Noted C – Amend and Resubmit D – Rejected E – Review not Required</p>	<p><b>CONTRACTOR:</b> Must certify one of the following statements pertaining to the transmittal or submittal sent for review:</p> <p><input type="checkbox"/> As the General Contractor for this project we certify that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work specified (no exceptions)</p> <p><input type="checkbox"/> As the General Contractor for this project we certify that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.</p>
--	--

Comments:

--

Certified by: \_\_\_\_\_  
(Contractor's Signature)

## SYSTEM OUTAGE REQUEST FORM

**System to be Shutdown:** \_\_\_\_\_

**SOR No.:** \_\_\_\_\_

Date of Shutdown: \_\_\_\_\_ Beginning at: \_\_\_\_\_ am/pm

Duration of Shutdown: \_\_\_\_\_ Critical Path Activity? ☐ yes ☐ no

Owner:		<b>Routing</b>	<b>Date Sent</b>	<b>Date Received</b>
Project:		Contractor/CM		
Contractor:		CM/Owner-Operations		
Regulatory Agency Notification Required? <input type="checkbox"/> yes <input type="checkbox"/> no      Is a Dry Run Required? <input type="checkbox"/> yes <input type="checkbox"/> no Combustible/Hazardous Gases Present? <input type="checkbox"/> yes <input type="checkbox"/> no      Confined Space Entry? <input type="checkbox"/> yes <input type="checkbox"/> no				
Describe work to be performed including detailed sequence of events, safety plan, protection of existing facilities, equipment to be used and contingency plan. Use additional sheets as necessary.				
Will you require assistance from Owner Operations? <input type="checkbox"/> yes <input type="checkbox"/> no Note: <i>Existing valves and controls shall be operated by Owner staff only</i>				
<b>Outage Contact Information</b>	<b>Name of Person on Call/Duty</b>	<b>Home Phone</b>	<b>Cell Phone</b>	
Contractor				
Construction Manager				
Owner Operations				
Design Consultant				
Additional Contractor Comments:		<b>CM / Owner / Design Consultant Review Action</b>  <input type="checkbox"/> SOR Acceptable with comments noted on attached.  <input type="checkbox"/> SOR Not Acceptable with reasons noted on attached. Re-Submittal is required.		
Certified by: _____ <div style="text-align: center;">(Contractor's Signature)</div>		<div style="display: flex; justify-content: space-between;"> <div>           _____            (Construction Manager's Signature)         </div> <div>           _____            Date         </div> </div>		

Name of Owner

**CERTIFICATE OF UNIT RESPONSIBILITY  
For Specification Section**

Section Number and Title

***In accordance with the contract documents, the undersigned manufacturer accepts unit responsibility for all components of equipment furnished under specification Section Section #. We hereby certify that these components are compatible and comprise a functional unit suitable for the specified performance and design requirements.***

\_\_\_\_\_  
Name of Corporation

\_\_\_\_\_  
Street Address

\_\_\_\_\_  
City, State and Zip Code

\_\_\_\_\_  
Notary Public

By: \_\_\_\_\_  
Duly Authorized Official

\_\_\_\_\_  
Commission Expiration Date

\_\_\_\_\_  
Name

\_\_\_\_\_  
Title

Seal:

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

## **SECTION 02071**

### **GEOTEXTILE FABRIC**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Geotextile fabric.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 02300 – Earthwork

##### **1.03 SUBMITTALS**

- A. Comply with Section 01330.
- B. Manufacturer's Data:
  - 1. Manufacturer's name and product information
  - 2. Certificate of Compliance
  - 3. Minimum Average Roll Values (MARV)

##### **1.04 DEFINITIONS**

- A. Geosynthetic – A planar product manufactured from polymeric material used with soil, aggregate, or other geotechnical engineering materials as an integral part of a civil engineering project.
- B. Geotextile – a permeable geosynthetic comprised solely of textile materials (nonwoven or woven comprised of various synthetic polymers and manufactured by numerous processes).

##### **1.05 FUNCTION**

- A. Filter Fabric:
  - 1. Used for subsurface drainage applications including retaining walls, trench drains and seepage control.
  - 2. Allows water to flow through the geotextile while retaining soil particles. Filter must perform for the life of the drainage system by resisting clogging.
- B. Rock Slope Protection Fabric:
  - 1. Provides protection from erosion and scour when used in conjunction with rock rip rap. Provides separation between earth and rock.
- C. Subgrade Enhancement Geotextile:
  - 1. Located beneath aggregate base of both paved and unpaved roadways. Used as solids separation barrier for below grade structures.

## 1.06 QUALITY ASSURANCE

- A. Treat geotextiles to resist degradation from exposure to sunlight.

## 1.07 DELIVERY, STORAGE AND HANDLING

- A. Deliver, unload, and store geotextile fabric in manufacturer's wrapping with a minimum amount of handling.
- B. Protect geotextile rolls from excessive dust, moisture, rainfall, mud, ultraviolet exposure, and debris.
- C. Follow manufacturer's recommendations regarding storage.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. One of the following or equal:
  - 1. US Fabrics
  - 2. TenCate Mirafi

### 2.02 MATERIALS

- A. General
  - 1. Fabric values are based on the State of California Department of Transportation Specifications (Section 96) except for Geomembrane Support Fabric.
- B. Filter Fabric
  - 1. Permeable, nonwoven
  - 2. Polypropylene, polyester or a combination of both
  - 3. When tested under the referenced ASTMs, the properties must have the values shown in the following table.
  - 4. Approved manufacturers
    - a. US Fabrics, US160NW for Class C
    - b. TenCate Mirafi, 160N for Class C

Filter Fabric (Caltrans 96-1.02B)				
Quality Characteristic	Test Method	Values		
		Class A	Class B	Class C
Permittivity (min, sec <sup>-1</sup> )	ASTM D4491	0.5	0.2	0.1
Apparent opening size, average roll value, (max, US standard sieve size)	ASTM D4751	40	60	70
Grab Breaking Load, 1-inch grip, in each direction (min, lb)	ASTM D4632	157		
Apparent elongation, in each direction (min, percent)	ASTM D4632	50		
Puncture strength, (min, lb)	ASTM D6241	310		

Filter Fabric (Caltrans 96-1.02B)				
Quality Characteristic	Test Method	Values		
		Class A	Class B	Class C
Trapezoid tearing strength, (min, lb)	ASTM D4533	56		
UV Resistance retained grab breaking load, 500 hours (min. percent)	ASTM D4355	70		

- C. Not Used
- D. Subgrade Enhancement Fabric
  - 1. Polyester or polypropylene.
  - 2. When tested under the referenced ASTMs, the properties must have the values shown in the following table.
  - 3. Approved manufacturers
    - a. US Fabrics

Subgrade Enhancement Geotextile (Caltrans 96-1.02O)						
Quality Characteristic	Test Method	Requirement <sup>(a)</sup>				
		Class A1	Class A2	Class B1	Class B2	Class B3
Elongation at break, (percent)	ASTM D4632	<50	≥50	<50	<50	≥50
Grab Breaking Load, 1-inch grip in each direction, (min, lb)	ASTM D4632	250	160	--	320	200
Wide width tensile strength at 5 percent strain, (min, lb/ft)	ASTM D4595	--	--	2,000	--	--
Wide width tensile strength at ultimate strength, (min, lb/ft)	ASTM D4595	--	--	4,800	--	--
Tear strength, (min, lb)	ASTM D4533	90	60	--	120	80
Puncture strength, (min, lb)	ASTM D6241	500	310	620	620	430
Permittivity, (min, sec-1)	ASTM D4491	0.05	0.05	0.20	0.20	0.20
Apparent opening size, (min, inches)	ASTM D4751	0.012	0.012	0.024	0.012	0.012
UV Resistance, retained grab breaking load, 500 hours, (min, percent)	ASTM D4355	70	70	70	70	70
<sup>(a)</sup> Values are based on minimum average roll value in the weaker principal direction except apparent opening size is based on maximum average roll value.						

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Subgrade and earthwork as specified in Section 02300.

### 3.02 PLACEMENT

- A. Roll Length: Sized to fit area of use. Minimum length of 300 feet for areas larger than 300 feet long.
- B. Handle geotextile fabric in a manner that will not damage fabric.

- C. Place geotextile with no wrinkles or folds.
- D. If the fabric is joined with overlap joints, the adjacent borders of the fabric must be overlapped be at least 24-inches. Overlap in the same directions that the cover material is placed.
- E. Install as shown on the Drawings and per manufacturer's installation instructions.

**END OF SECTION**



## **SECTION 02081**

### **CONTROLLED LOW STRENGTH MATERIAL**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Requirements for controlled low strength material (CLSM) as backfill material in specific locations.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section:
  - 1. Section 01330 – Submittals
  - 2. Section 03301 – Cast-in-Place Concrete

##### **1.03 DEFINITION**

- A. Controlled low strength material (CLSM): A highly flowable, lean concrete mix consisting of a mixture of cement, fly ash, densely graded mineral aggregates, water and admixtures. Characteristics include:
  - 1. Capable of freely flowing to fill excavations and voids without compaction or other additional effort.
  - 2. Used in trenches and for backfill adjacent to structures where clearance is limited, and in other areas specifically identified on the Drawings or specified.
  - 3. Low permeability to prevent migration of adjacent fines into the set mix.
  - 4. Easily excavated after curing with minimum risk of damage to buried utility.

##### **1.04 SUBMITTALS**

- A. Comply with Section 01330.
- B. Mix Design: Identify name and/or number of the mix design and proposed use. Provide the proportions and gradations of materials proposed for CLSM.
- C. Certified test results for compressive strength.

##### **1.05 QUALITY ASSURANCE**

- A. Demonstrate that the CLSM mix meets the specified requirements, including compressive strength.
- B. Enlist the services of a testing laboratory to prepare test cylinders and to transport cylinders to the laboratory for testing.
- C. Testing expenses shall be borne by the Contractor.
- D. Test Cylinders
  - 1. Procedure: Make 6-inch diameter by 12-inch high test cylinders in accordance with ASTM D4832.

2. Required Number: Not less than 3 cylinders for each 200 cubic yards of CLSM placed, with a minimum of 3 cylinders for each location where CLSM is used.
  3. Test two cylinders at 28 days, third cylinder is spare.
- E. Field Testing:
1. Test flow consistency per ASTM D6103.
  2. Test flow consistency once every 200 cubic yards of CLSM placed.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. CLSM Mix: A mixture of Portland cement, fly ash, aggregate, water, and admixtures that produce a material of controlled density and of low compressive strength capable of filling all spaces between the pipe, the bedding and the trench walls.

### **2.02 MATERIALS**

- A. Cement: Conforming to ASTM C150, Type II or III with total alkali content not more than 0.8 percent.
- B. Water: Clean, potable water.
- C. Fly Ash
1. Mix Designs used for Pipe Bedding and Trench Backfill: Class F in conformance with ASTM C618.
  2. Mix Designs used for Backfill of Excavations: Class F in conformance with ASTM C618.
- D. Aggregate Materials
1. Densely graded rock conforming to the following gradation:

Sieve Size	Percentage Passing
1"	100
No. 8	50-100
No. 200	0-5

### **2.03 DESIGN REQUIREMENTS**

- A. Water-cement Ratio: Not to exceed 3.5.
- B. Minimum Cement Content: 50 pounds per cubic yard.
- C. Use fly ash to improve flow-ability of the fresh CLSM and to regulate the strength. Do not use more than 300 pounds per cubic yard.
- D. Unit Weight Requirements
1. Density of CLSM when used as backfill of excavations: Between 100 pounds per cubic foot and 130 pounds per cubic foot in the as-placed condition as determined by ASTM D6023.

- E. Compressive Strength Requirements
  - 1. Mix Designs used for Pipe Bedding and Trench Backfill: Compressive strength at 28 days between 100 psi and 150 psi as determined in accordance with ASTM D4832.
  - 2. Mix Designs used for Backfill of Excavations: Compressive strength at 28 days between 150 and 300 psi as determined in accordance with ASTM C4832.
  - 3. Mix Designs used for Excavation Support and Protection in conformance with Section 03301.

#### 2.04 CONSISTENCY AND MIXING

- A. Consistency: Similar to that of a thick liquid so that it flows readily and fills spaces and voids around pipes and structures.
- B. Slump: Between 6 inches and 8 inches when tested in accordance with ASTM C143.
- C. Uniform consistency and appearance.
- D. Mixing Method and Time: As required to produce a uniform mixture of cement, fly ash, aggregate, admixtures, and water.

#### 2.05 MEASUREMENT OF MATERIALS

- A. Use weighing equipment to determine the amount of cement, fly ash, and aggregate entering into each batch. Where batches are proportioned to contain an integral number of conventional sacks of cement, and the cement is delivered at the mixer in the original unbroken sacks, the weight of the cement contained in each sack may be taken without weighing as 94 lbs.
- B. Use a suitable water meter or other acceptable method of measuring the quantity of water entering the mixer.

### **PART 3 - EXECUTION**

#### 3.01 PLACEMENT

- A. Thoroughly settle and consolidate CLSM as the material is placed in excavations. Fill the entire depth of the layer that is being consolidated, into a dense, homogeneous mass, filling all spaces and voids and bringing only a slight excess of water to the exposed surface. Place and consolidate CLSM by means that will not cause segregation of the mix.
- B. Do not place CLSM under the following conditions:
  - 1. When the air temperature is below 40 degrees Fahrenheit.
  - 2. When the excavation contains water or when the bottom or walls of the excavation are frozen or contain frozen material.
- C. Prevent flotation of pipes by placing CLSM in two or more lifts, with each lift reaching an initial set before the succeeding lift is placed. Correct any flotation and displacement of pipelines.
- D. Placement of CLSM in Excavations: Limit lift thickness to 10 feet, place subsequent lifts after CLSM has achieved the minimum specified compressive strength.

### 3.02 PROTECTION OF CLSM

- A. Protect CLSM from equipment, traffic and backfilling operations until the surface has achieved an initial set and has hardened enough to develop a minimum penetration number of 650 when tested in accordance with ASTM C403.
- B. If the trench backfill is not to be placed over the CLSM within eight hours after CLSM placement, place a 6-inch layer of moist backfill over the CLSM.

**END OF SECTION**

**SECTION 02200**  
**SITE PREPARATION**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Site preparation work, as follows:
  - 1. Locating existing facilities.
  - 2. Installing safety and protective barriers.
  - 3. Constructing temporary access roads, work areas and storage areas.
  - 4. Clearing, grubbing, stripping, and other initial work required for earthwork and trenching operations.

1.02 REFERENCED SECTIONS

- A. The following Sections are referenced in this Section
  - 1. Section 01112 – Site Conditions
  - 2. Section 01330 – Submittals
  - 3. Section 02210 – Subsurface Investigations

1.03 DEFINITIONS

- A. Clearing: Consists of removal of natural obstructions and man-made objects and features including foundations, buildings, fences, lumber, stumps, debris, rubbish, brush, trees, boulders, and other items that interfere with construction operations or are specifically designated for removal.
- B. Stripping: Includes the removal and disposal of sod, grass, weeds, roots, and other organic material remaining after clearing has been completed.
- C. Top Soil: The native or cultivated surface-soil layer containing organic matter and typically consisting of a darker shade of brown, grey or red than the underlying subsoil. For the purposes of this project, the top 6 inches of soil in open areas is considered topsoil.

1.04 SUBMITTALS

- A. Comply with Section 01330.
- B. Submit:
  - 1. Materials used and layout of temporary fences
  - 2. Proposed staging and stockpile locations.

**PART 2 - PRODUCTS**

2.01 TEMPORARY FENCES

- A. Type: Heavyweight, high visibility, flat laminar mesh design.
- B. Material: High-density polyethylene.

- C. Height: 48 inches.
- D. Posts: Wood or metal posts at 10-foot spacing. Secure fence to posts with plastic cable ties.

### **PART 3 - EXECUTION**

#### **3.01 LOCATING EXISTING FACILITIES**

- A. Review the design drawings, maps, and other sources of information and identify existing facilities at the site to determine and mark the approximate locations of underground facilities.
- B. Follow rules adopted by the Oregon Utility Notification Center regarding locating and marking existing buried utilities and contact owners of existing underground utilities prior to beginning work in the vicinity of their utilities. Comply with requirements of Section 01112.
- C. Refer to Section 02210. Locate all existing utilities by exploratory excavations after field marking by the utility agencies and prior to any excavations in the affected areas.

#### **3.02 SAFETY AND PROTECTIVE BARRIERS**

- A. Along Public Roadways:
  - 1. Install appropriate barriers such as temporary fencing, plastic drums, or concrete traffic barriers to protect public from construction areas and to protect workers and existing facilities from danger of passing vehicles.
- B. Temporary Fences:
  - 1. Prior to beginning excavation, erect temporary fences along boundaries where required.
  - 2. Maintain work activities within the confines of the temporary fences.
  - 3. Remove temporary fences when work in the vicinity is substantially complete.
- C. Existing Trees: Erect temporary fences around trees at the drip line that are adjacent to the Work and may be subject to damage unless protected. Maintain work activities outside of protected areas.
- D. Provide protective concrete slabs, steel plates or encasements for existing buried facilities that may be damaged by Contractor's equipment and vehicles.

#### **3.03 PRIMARY SITE ACCESS, WORK AND STORAGE AREAS**

- A. Develop primary access routes, work areas and storage areas as indicated on the Drawings.
- B. Clean up areas at the conclusion of the project and return the areas to their original or better condition.

#### **3.04 CLEARING**

- A. Clear construction areas of objectionable items and material, which, if left in place, would interfere with the proper performance of the work.
- B. Remove loose boulders within 10 feet from the tops of cut slopes. Incorporate boulders into landscaping or remove from the site.
- C. Dispose of material from clearing operations in an acceptable off-site location.

3.05 STRIPPING

- A. Remove the top layer of soil containing sod, grass, weeds and other vegetation to a depth of 6 inches from areas that will be affected by construction and site grading operations.
- B. Extend stripped areas at least 4 feet beyond the limits of cut and fill areas.
- C. Dispose of stripped material in an acceptable off-site location.

3.06 REMOVAL OF SLUDGE AND SLUDGE ENTRAINED SOILS (NOT USED)

- A. from the areas indicated on the Drawings.

3.07 REMOVAL AND REPLACEMENT OF TOP SOIL (NOT USED)

3.08 TREE REMOVAL (NOT USED)

3.09 TREE TRIMMING (NOT USED)

3.10 REMOVAL OF EROSION CONTROL DEVICES

- A. Remove erosion control devices when bare soils are sufficiently revegetated to prevent on-site or off-site soil erosion.
- B. Straw wattles containing plastic netting, including plastic specified as phot-degradable, may not remain on site. Remove entire wattle or remove and dispose of plastic netting and spread straw from wattle across vegetated areas of site.

**END OF SECTION**

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## **SECTION 02210**

### **SUBSURFACE INVESTIGATIONS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Requirements for subsurface investigations for locating existing utilities and points of connection to existing systems

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section:
  - 1. Section 01330 – Submittals

##### **1.03 SUBMITTALS**

- A. Comply with Section 01330.
- B. Submit completed subsurface investigation report.

#### **PART 2 - PRODUCTS (NOT USED)**

#### **PART 3 - EXECUTION**

##### **3.01 GENERAL**

- A. Contact Oregon 811 and have existing utilities marked prior to performing field investigations.
- B. No additional compensation will be provided for locating utilities whether or not the utility is shown with reasonable accuracy on the Drawings.
- C. Survey of existing utility field locations shall be conducted by a firm or individual that possesses a valid state registration for land surveying. Provide survey information using the same basis used for the Project.

##### **3.02 FIELD INVESTIGATIONS**

- A. Perform field investigations prior to preparation of Shop Drawings for underground piping, and prior to excavation for installation of any underground facilities.
- B. Field locate existing underground utilities and other interferences shown on the Drawings or marked by Oregon 811 and facilities where connections will be made as part of the Work. At a minimum, locate the following existing underground facilities:
  - 1. Crossing utilities up to 2 feet beneath the proposed utility or structure subgrade.
  - 2. Parallel utilities within 5 feet of the nearest trench wall of proposed utility or structure. Locate parallel utilities at a minimum every 100 feet. Decrease the spacing as necessary to accommodate fluctuations in the alignment of the existing utility.
  - 3. Proposed connections to existing underground utilities or facilities.

4. Any other existing underground utility or facility that may affect the installation of the proposed underground facilities.
- C. Determine the following properties of each existing underground utility and interference.
1. Horizontal location, including the design station or coordinates where the existing utility will cross or interfere with the proposed underground facility.
  2. Elevation of the top and bottom of the existing utility. For round utilities, bottom elevation can be estimated provided the outside diameter of the utility is determined. For box-shaped utilities or conduit banks, excavate to the bottom of the utility to determine the bottom elevation.
  3. The utility size, material type, and type of existing backfill
- D. Determine the following properties for each connection to existing underground utilities or structures:
1. Horizontal location of the proposed connection point.
  2. Elevation of the top and bottom at the proposed connection point.
  3. Horizontal and vertical angle of existing utility in reference to the proposed underground utility.
  4. The utility size, material type, and type of existing backfill
- E. Prepare a detailed field investigation report to include the information described above. Organize the report by station.
- F. Following excavation and field data gathering, backfill excavations, and within paved areas, restore the surface pavement to match the material and thickness of the pre-investigation pavement unless otherwise required by the jurisdiction having authority over the pavement repairs.

**END OF SECTION**

## **SECTION 02240**

### **DEWATERING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Control of water and dewatering of trench and structure excavations. A monitoring and groundwater well will be operated by the City during construction. The location of the well is shown on the drawings. The well does not completely dewater the area and the Contractor will be responsible for additional dewatering and disposal of water.

##### **1.02 RESPONSIBILITY FOR DESIGN**

- A. Assume responsibility for planning, design, installation and operation of temporary groundwater dewatering systems and temporary surface water control systems. Water control systems designed and installed by the Contractor shall adequately protect existing property, foundations and permanent structures.
- B. Utilize the services of a Registered Hydrogeologist, Professional Civil Engineer, or Certified Engineering Geologist to develop the Groundwater Control Plan (GWCP) and the design of the groundwater and surface water control systems to achieve specified results. Professional registration shall be for the State of Oregon.
- C. Assume sole responsibility for loss or damage resulting from partial or complete failure of operation of dewatering systems.
- D. Assume responsibility for repairing damage to adjacent properties, buildings, structures, utilities and other work due to settlement or resultant damage caused by the groundwater control operations.
- E. Determine means and methods for disposing of water removed by dewatering systems. If permit requirements specify water quality requirements that must be met before water can be disposed, provide the necessary treatment facilities to achieve the specified water quality limits.
- F. Modify groundwater control systems or operations if they cause or threaten to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells, or affect potentially contaminated areas.
- G. When additional information is needed for design of dewatering systems, conduct subsurface investigations to identify groundwater conditions and to provide parameters for design, installation, and operation of groundwater control systems

##### **1.03 RESPONSIBILITY FOR SECURING PERMITS**

- A. Obtain all necessary permits, including those required by Oregon Water Resources Department (OWRD) for dewatering wells and monitoring wells, those required by the Department of Environmental Quality for discharge of groundwater to stormwater facilities, and those required by the City of Cottage Grove for discharge to the local sewer system.
- B. Pay all costs associated with permitting, decommissioning and removal of all dewatering systems when no longer in use.

- C. Comply with the sampling, testing, monitoring, and reporting requirements specified in permits secured for dewatering operations.

#### 1.04 PERFORMANCE REQUIREMENTS

##### A. General

1. Groundwater control systems may include single-stage or multiple-stage well point systems, sump pumps within excavations, shallow or deep wells, or combinations of these types of dewatering systems.
2. Locate groundwater control and drainage systems so as not to interfere with utilities, construction operations, vehicular traffic, adjacent properties, or adjacent water wells.
3. Modify dewatering procedures which cause, or threaten to cause, damage to new or existing facilities, so as to prevent further damage. Install settlement gauges, as necessary, to monitor settlement of critical structures or facilities adjacent to areas of dewatering. Control the rate of dewatering to avoid all objectionable settlement and subsidence.
4. Install piezometers to monitor groundwater in the area of the excavation, as well as the natural groundwater elevation. Install piezometers in the locations specified elsewhere in this Section.
5. Remove or abandon dewatering system when it is no longer needed in accordance with regulatory stipulations indicated in this Section.

##### B. Project Conditions

1. Anticipate encountering groundwater in all excavations.
2. Groundwater may be free-flowing into excavations or may be encountered in the form of saturated soil.

##### C. Requirements for Dewatering of Excavations:

1. Design dewatering systems of sufficient scope, size, and capacity to accomplish the following results:
  - a. Control the flow of surface water into trench and structure excavations by grading, dikes, or other means.
  - b. Lower groundwater levels and eliminate infiltration of groundwater into trench and structure excavations, allowing construction to proceed on dry, stable subgrade.
  - c. Lower and maintain groundwater to a level at least two feet below the lowest point of excavations.
  - d. Lower groundwater levels further when necessary to obtain the specified degree of compaction. Develop substantially dry and stable subgrade for subsequent earthwork compaction and construction operations.
  - e. Prevent the loss of fines, seepage, boils, quick conditions, or softening of the foundation soils.
  - f. Maintain stability of sides and bottoms of excavations.

D. Requirements for Protection of Existing Structures

1. Provide, operate and maintain dewatering systems of sufficient size and capacity to protect existing structures from hydrostatic uplift when the structure is drained of water.
2. Protection against hydrostatic uplift entails lowering the groundwater table in the immediate vicinity of the structure to be drained until the groundwater elevation is at least 12 inches below the top of slab elevation of the structure.

E. Operation of Dewatering Systems

1. Maintain dewatering operations to control and minimize erosion, to create stable sides and bottoms of excavations, to stabilize constructed slopes and to prevent settlement and damage to structures and utilities.
2. Collect and dispose of removed water. Water removed by dewatering systems cannot be discharged into the storm water collection system which consists of pipes, catch basins, manholes and roadside drainage ditches.

1.05 PROJECT SPECIFIC DESIGN REQUIREMENTS (NOT USED)

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Comply with requirements of agencies having jurisdiction.
- B. Comply with all laws and regulations for development, drilling, and abandonment of wells used in dewatering systems.
- C. Obtain a 1200-C Storm Water Discharge General Permit from the Oregon Department of Environmental Quality (DEQ) under the National Pollutant Discharge Elimination System (NPDES) for discharge of collected groundwater from the construction site.
- D. Obtain all necessary permits from agencies with regulatory jurisdiction over groundwater pumping, matters affecting well installation and the use of existing storm drains and natural water drainage courses.
- E. Take early action and allow time for the review, as permitting processes may be lengthy. Take early action to pursue and submit for the required approvals.

1.07 SUBMITTALS

- A. Notify the Owner's Representative immediately after any material change or proposed change in the character, volume, treatment or disposal methods of the discharge.
- B. Additional Shop Drawings for Specific Locations
  1. Submit design details of dewatering systems and water treatment systems that will be utilized at the specific locations listed herein.
  2. Design of the dewatering system shall be prepared by a professional civil, structural or geotechnical engineer registered in the state of Oregon and shall be coordinated with the design of the excavation support systems that the Contractor proposes to use at these locations.
  3. Provide shop drawings that are signed and sealed by the responsible Engineer, Architect or Certified Professional.

4. Illustrate the arrangement, locations and details of the dewatering system, including wells and well points; dewatering pumps and piezometers; locations of headers, treatment systems and discharge lines; standby equipment and power supply; silt removal, pollution control and treatment facilities; and the means of conveyance, discharge and disposal of water.
5. Include a narrative report outlining the dewatering procedures and controls.
6. Submit a minimum of six weeks before any work referred to in the submittal is scheduled to commence.

C. Groundwater Control Plan (GWCP)

1. Proposed plan for the design, control, transport, treatment, operation, disposal of water, signed and sealed by the designer. Include with this proposed plan a drawing that indicates the number and location of the dewatering wells to be installed for the Work.
2. Include the following in the GWCP:
  - a. Calculations for the design of each system, including a statement of design assumptions, system description, and basic design criteria. Quantify the peak discharge rate of each system into receiving storm water and sanitary sewers.
  - b. Schedule and procedures for installation, start-up testing protocol, and removal of each system.
  - c. Location, dimensions, and capacity of wells, retention basins, treatment ponds, tanks, and treatment plants.
  - d. Sizes, locations, and types of discharge lines, ditches, sumps, and flow measurement devices.
  - e. Details of dewatering systems for shafts, including well sizes, locations, gradation of filter materials, and calculations for compatibility with screen and ground.
  - f. Types, capacities and numbers of pumps, generators, and standby units.
  - g. Design and construction of all electrical installations.
  - h. Details for the collection of water in tunnel and shafts, its conveyance to the treatment point, its treatment of the water, and its discharge from the site.
  - i. Methods of measuring the flows in accordance with the requirements specified herein.
  - j. List of substances that may be introduced into discharges or increased in concentration due to the Contractor's means and methods of performing the Work.
  - k. Methods of monitoring groundwater level and water quality to check its compliance with all regulatory requirements prior to its discharge from the site.
  - l. Methods for diverting or collecting, monitoring, and treating as necessary prior to discharge all storm water.
  - m. Methods for collecting, handling, treating and disposing of water and byproducts from excavated materials stockpiled on site.
  - n. Copy of approved permits (i.e. discharge permits).

3. Copies of all daily reports specified herein.
4. Timing: Submit GWCP within 21 calendar days of the Notice to Proceed.

#### 1.08 QUALITY CONTROL

##### A. Qualifications:

1. Name, address, phone number and professional registration of the designer of the dewatering systems.
2. Company and individuals responsible for the operation of the facilities.
3. Independent testing laboratory responsible for testing treated effluent will be arranged for and provided by the City.

##### B. Certifications: Permit for discharge into local storm water and sewer systems.

##### C. Quality Control Plans:

1. Method for assuring that water quality complies with regulatory requirements prior to its discharge from the site.
2. Methods demonstrating the ability of the automatic paging facilities, power transfer facilities, and backup systems to comply with specified requirements.
3. Methods for assuring that collection, handling, treatment, and discharge operations do not damage the Work in progress or impact the efficiency with which other Work is performed.
4. Calculations demonstrating capacity of system to store collected water on site to comply with permit restrictions for discharging.
5. Recordkeeping: Flow, water quality, and amount and type of treatment chemicals used on a cumulative basis. Provide daily, no later than 8 hours after records were taken.

##### D. Shop drawings of the dewatering system must be approved prior to beginning excavations.

#### 1.09 QUALITY ASSURANCE

##### A. Reference Standards: Except as otherwise indicated the current editions of the following specifications and standards apply to the Work of this Section:

1. Oregon Administrative Regulations (OAR):
  - a. OAR 690-200, Well Construction and Maintenance.
  - b. OAR 60-210, Abandonment of Wells.
  - c. OAR 690-240 Construction, Maintenance, Alteration, Conversion and Abandonment of Monitoring Wells Geotechnical Wells, and Other Holes in Oregon.
2. Environmental Protection Agency (EPA)
  - a. 40 CFR 136 - Guidelines Establishing Test Procedures for the Analysis of Pollutants.
  - b. 40 CFR 261 - Identification and Listing of Hazardous Waste.
  - c. 40 CFR 403 - General Pretreatment Regulations for Existing and New Sources of Pollution.

3. Qualifications:
  - a. Designer of GWCP: Registered Hydrogeologist, Professional Civil Engineer, or Certified Engineering Geologist registered in the State of Oregon with a minimum of five years experience in the design, including monitoring and recording, of water collection, handling, and treatment systems similar to those required under this Contract.
  - b. Installer and Operator:
    - 1) Company with at least five years experience in responsible charge of the installation and operation of water collection, handling, and treatment systems similar to those required for this project.
    - 2) Personnel operating and maintaining facilities with demonstrated experience in the operation of systems similar to those required for this project.
4. Preconstruction Meeting: Prior to beginning excavation, complete installation of the water treatment facility and arrange for a demonstration and test of all features, including automatic paging facilities, power transfer facilities and backup systems.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS AND EQUIPMENT**

- A. Furnish and maintain all materials, tools, equipment, facilities, and services as required for providing the necessary dewatering work and facilities.
- B. Materials for Groundwater Extraction Wells and Groundwater Monitoring Wells:
  1. Well Casing: Schedule 40 PVC or steel pipe. Size to be determined by Contractor, 8-inch minimum.
  2. Piezometer Casing: 2-inch diameter PVC pipe with 20 foot section of slotted screen.
  3. Sand Pack: 10x20 silica sand.
  4. Pump Size, Capacity, and Type (Extraction Wells): As selected by Contractor.
  5. Provide locking security cap on top of well casing.
- C. Collection and Discharge Pipes: Steel or PVC pipe and fittings.
- D. Water Quality Treatment Equipment: Provide settling tanks with sufficient capacity for the flow rate and volume of water. Include chemical flocculation and filtration equipment as necessary to comply with water quality limits.

### **2.02 DEWATERING AND WATER CONTROL EQUIPMENT**

- A. Select equipment and materials necessary to achieve desired results for dewatering.
- B. Use equipment that is in good repair and operating order.
- C. Maintain sufficient standby equipment and materials available at the site to ensure continuous operation, where required.



## 2.03 GEOTEXTILE CONTAINMENT TUBES

- A. Contractor may utilize a pervious geotextile containment tube for capturing and removing sediment from water collected during dewatering operations.
- B. Tube Construction: Fabricated from woven, mono-filament or multi-filament pervious sheets of geotextile material and provided with filling ports and a pressure relief port.
- C. Manufacturers: One of the following or equal:
  - 1. Geocontainer, as manufactured by Ten Cate Nicolon.
  - 2. Geotube, as manufactured by Texion Geosynthetics.

## PART 3 - EXECUTION

### 3.01 NPDES PERMIT COMPLIANCE

- A. Implement the Groundwater Control Plan as approved by the Oregon DEQ before beginning excavation.
- B. Comply with all limitations and controls for water discharges, monitoring requirements and other special conditions specified in the permit.

### 3.02 MONITORING GROUNDWATER

- A. Piezometers:
  - 1. Install four piezometers, evenly distributed around the clarifier, for use in monitoring groundwater elevation.
  - 2. Measure and record groundwater elevation two times per week during the course of dewatering to lower the groundwater table.
  - 3. When piezometers are no longer needed for monitoring ground water levels, abandon piezometers in accordance with Applicable laws and regulations.
- B. Installation of Monitoring Devices
  - 1. Construct well in accordance with the requirements of ASTM D5092, Standard Practice for Design and Installation of Groundwater Monitoring Wells.
  - 2. Depth of Drilled Hole: Minimum 10 feet below required elevation of groundwater drawdown.
  - 3. Construction Methodology: Install monitoring wells using methods that do not use drilling mud.

### 3.03 DEWATERING

- A. Perform dewatering in accordance with approved Shop Drawings. Keep the Owner's Representative advised of any changes made to accommodate field conditions and, on completion of the dewatering system installation, revise and resubmit Shop Drawings as necessary to indicate the installed configuration.
- B. Organize dewatering operations to lower the groundwater level in excavations as required for prosecution of the Work, and to provide a stable, dry subgrade for the prosecution of construction operations.

- C. Maintain water level at lower elevations, so that no danger to structures can occur because of buildup of excessive hydrostatic pressure, and provide for maintaining the water level a minimum of two feet below the subgrade, unless otherwise permitted by the Owner's Representative.
- D. Maintain groundwater level a minimum of five feet below the prevailing level of backfill being placed.
- E. Dispose of water in such a manner as to cause no injury or nuisance to public or private property, or be a menace to the public health. Dispose of the water in accordance with applicable regulatory agency requirements.
- F. Dewatering of Pipe Trenches: Do not drain trench water through the pipeline under construction.
- G. Maintain continuous dewatering operations so that the excavated areas are kept free from water during construction, while concrete is setting and achieves full strength, and until backfill has been placed to a sufficient height to anchor the work against possible flotation.
- H. Prevent disposal of sediments to adjacent lands or waterways by employing necessary methods, including settling basins. Locate settling basins away from watercourses to prevent silt-bearing water from reaching the watercourse.
- I. Where excavations may obstruct the natural flow of a watercourse, implement measures to control and dispose of the surface water that will not adversely affect water quality or beneficial uses of the watercourse. Divert watercourse flows around excavation areas by constructing barriers, temporary culverts, new channels or other appropriate means.
- J. Do not allow water containing mud, silt or other pollutants from aggregate washing or other construction activities to enter a watercourse or be placed in locations that may be subjected to high storm flows.

#### 3.04 SETTLEMENT MONITORING

- A. Prior to beginning dewatering operations in the vicinity of existing structures, establish temporary benchmarks to monitor stability of the following existing structures:
  - 1. Secondary Clarifier. Establish 2 benchmarks on opposite sides of the structure.
- B. Monitor benchmarks once per week.
  - 1. Provide survey data to the Engineer.
  - 2. If movement is greater than 0.10 inch over any 5-day period, increase monitoring to 3 times per week.
  - 3. If movement is greater than 0.15 inches over any week period, increase monitoring to daily.
  - 4. If total movement exceeds 0.50 inches from the original benchmark location, cease work in the vicinity and submit a plan to modify the construction methodology to prevent further movement and develop a remediation plan for correcting additional movement. Work shall not proceed further until the correction plan is approved by the Engineer.

#### 3.05 SURFACE WATER CONTROL

- A. Intercept surface water and divert it away from excavations through use of dikes, ditches, curb walls, pipes, sumps or other means. This requirement extends to temporary works

required to protect adjoining properties from surface drainage caused by construction operations.

- B. Implement the appropriate level of surface water control to protect water quality throughout the construction period.
- C. Utilize Best Management Practices throughout the construction period.

### 3.06 GROUNDWATER CONTROL

- A. Provide labor, material, equipment, techniques and methods to lower, control and handle groundwater in a manner compatible with construction methods and site conditions. Monitor effectiveness of the installed system and its effect on adjacent property.
- B. Intercept water flowing into excavations and divert it to sumps or ditches to allow pumping of collected water out of the excavation.
- C. Provide settling basins, geotextile containment devices or other sediment removal and water treatment devices for water quality control and compliance with regulatory and permit requirements.
  - 1. Install geotextile containment devices in accordance with the manufacturer's instructions and requirements.
- D. Operate and maintain groundwater control systems in accordance with the Groundwater Control Plan. Notify Engineer in writing of any changes made to accommodate field conditions and changes to the Work.
- E. Provide for continuous system operation, including nights, weekends, and holidays. When deemed appropriate, provide backup power source for electrical service.
- F. Monitor operations to verify that the system lowers groundwater levels at a rate required to maintain a dry excavation resulting in a stable subgrade for prosecution of subsequent operations.
- G. Remove all groundwater control systems upon completion of construction or when dewatering and control of surface or groundwater is no longer required. Remove and grout piezometers when groundwater control operations are complete.

### 3.07 WELL ABANDONMENT

- A. Abandon wells using a licensed water well contractor in accordance with OAR 690-220.
- B. Include well abandonment costs, including permits and documentation, in the Lump Sum Price.

### 3.08 RECORDS

- A. Provide a daily record of the average flow rate. Provide results of water quality testing as required by the Permit for discharge.
- B. Observe and record the elevation of the groundwater during the period that the dewatering system is in operation.

**END OF SECTION**

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## **SECTION 02260**

### **EXCAVATION SUPPORT AND PROTECTION**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Temporary excavation support systems.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 02081 – Controlled Low Strength Material
  - 3. Section 02240 – Dewatering
  - 4. Section 02300 – Earthwork
  - 5. Section 03600 – Grout

##### **1.03 DEFINITIONS**

- A. Protection Systems:
  - 1. Sloping or benching systems for excavated slopes.
  - 2. Structural support systems, shield systems, and other systems for preventing excavation wall failure.

##### **1.04 SUBMITTALS**

- A. Prepare and submit in accordance with Section 01330.
- B. Submit information as a complete package. Include all items required by the Contract Documents. Incomplete submittals will not be reviewed and will be returned for resubmittal as a complete package.
- C. Shop Drawings
  - 1. Prepared, signed and sealed by a professional engineer who is registered to practice in the state of Oregon.
  - 2. Clearly indicate structural sections of shoring members, welding details, bolting details and bracing details.
  - 3. Indicate existing and new structures, pipelines and other improvements located in the vicinity and impacting the design of the shoring system.
  - 4. Provide details for bracing, reinforcement and sealing around penetrations.
- D. Calculations: Structural calculations verifying and demonstrating the structural safety and adequacy of the sheeting, shoring and bracing to be used.
  - 1. Prepared, signed and sealed by a registered Professional Civil or Structural Engineer who is registered to practice in the State of Oregon.

2. Provide calculations for the different load, support and other conditions that occur during the sequence of installation, construction of facilities protected by the shoring and the sequence of removal of the internal bracing and shoring.
- E. Sheet Pile Driving Equipment: Information on type of equipment to be used, including manufacturer, model number and driving energy.
- F. Qualifications of registered Professional Engineer and shoring installer, including project references.
- G. Prepare a detailed plan illustrating the sequence of installation and removal of shoring systems and internal bracing. Include sketches showing the various stages in the sequence.
- H. Letter confirming installation of the shoring system is in accordance with the shoring design.
- I. Control Points and Stability Measurements:
  1. Submit proposed location and details of control points and method and schedule for obtaining stability measurements.
  2. Submit field notes documenting stability measurements.

#### 1.05 INSTALLER QUALIFICATIONS

- A. Shoring installer must have a minimum of five successful past installations of shoring systems of comparable overall heights and comparable penetration of soils similar to those found on the project site.

#### 1.06 PERFORMANCE REQUIREMENTS

- A. Design and install excavation support and protection systems that are capable of:
  1. Supporting excavation sidewalls and bottom to maintain the required excavation or trench section.
  2. Resisting soil and hydrostatic pressure and superimposed construction loads and other live loads.
  3. Protecting existing facilities in the vicinity of the excavation from damage due to settlement or movement of soil
- B. Provide professional engineering services necessary to assume engineering responsibility, including preparation of Shop Drawings and a comprehensive engineering analysis by a qualified professional engineer registered in the State of Oregon.
- C. Install and remove excavation support and protection systems without damaging existing buildings, pavements, utilities, railroad facilities and other improvements adjacent to excavation.
- D. Excavations
  1. Protect workers from hazard of caving ground and other hazards.
  2. Install excavation protection system in locations where:
    - a. Protection system is specifically indicated on the Drawings.
    - b. Excavations are equal to, or greater than, 5 feet deep.
    - c. Excavations are less than 5 feet deep, but there is a potential for cave-in.

- d. When engineering analyses prepared by the Contractor indicate the stability of existing structures and facilities may be jeopardized by settlement or movement of soil.

#### 1.07 GENERAL DESIGN REQUIREMENTS

- A. Design excavation support systems to meet requirements and standards of the Occupational Safety and Health Administration (OSHA).
- B. Design excavation support systems to meet the requirements of Oregon Administrative Rules, Chapter 437, Division 3, Subdivision P.
- C. Design structural steel members in accordance with the American Institute of Steel Construction (AISC) Manual of Steel Construction Allowable Stress Design and the Uniform Building Code.
- D. Excavation support systems for trench excavations shall be selected by the Contractor based on the soil conditions, depths of trench excavations, groundwater conditions and other site conditions. No attempt has been made by Engineer to define acceptable trench shoring options.
- E. Excavation support systems for structural excavations may consist of either driven steel sheet piling or soldier beam and lagging systems complying with requirements of this Section. Contractor may select from either specified system.
- F. Allowable Deflection: Not more than 1/2-inch at any point on the shoring system.
- G. Cantilevered Design Limits:
  - 1. Maximum height of cantilevered shoring above the bottom of the excavation shall not exceed 15 feet.
- H. Resistance to Overturning
  - 1. Design soldier piles and sheet piles with sufficient depth below the excavation to:
    - a. Resist lateral movement or overturning of the pile, and
    - b. Act as an effective water cutoff to prevent heaving or flow of soil into the excavation.
  - 2. Calculate the required depth of pile below the bottom of the excavation by assuming the soil immediately below the bottom of excavation does not provide passive resistance for a depth of 1.5 times the effective pile diameter.

#### 1.08 DESIGN REQUIREMENTS FOR SOLDIER PILES AND LAGGING

- A. Design soldier piles for downward loads including vertical loads from tie back anchors.
- B. Flexural Strength of Lagging: In accordance with the Uniform Building Code, but not greater than 1,500 psi.
- C. Wales: Use back-to-back structural members.
- D. Soil Anchors, Rock Anchors and Deadmen Anchors:
  - 1. Design tie back anchors with a safety factor of not less than 2 times the calculated load from the shoring.

2. When calculating the length of soil anchors needed to resist the load from the shoring, do not include any anchor length within the potential active pressure soil failure zone behind the face of the shoring.
3. Design anchor tie rods for 130 percent of the calculated load from the shoring.
4. When tie rod couplings are used, design anchor tie rods for 150 percent of the calculated load from the shoring.

1.09 GEOTECHNICAL REPORT (NOT USED)

1.10 PROJECT SPECIFIC DESIGN REQUIREMENTS (NOT USED)

1.11 JOB SITE POSTINGS

- A. Maintain at least one copy of the protection system design at the job site while the excavation is open in accordance with the requirements of Oregon Administrative Rules, Chapter 437, Division 3, Subdivision P.

1.12 SEQUENCE AND SCHEDULING

- A. Do not begin excavations or installation of excavation supports until submittals for excavation support systems have been accepted by the Engineer and until materials necessary for installation are on site.
- B. Allow a minimum of 30 calendar days for Engineer's review of submittals for excavation support systems.
- C. Do not begin excavations or installation of excavation supports until initial survey measurements on control points on existing structures and other improvements are obtained to document initial elevations and locations.

## **PART 2 - PRODUCTS**

2.01 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel Soldier Beams: ASTM A36, ASTM A690 or ASTM A992.
- C. Steel Sheet Piling: ASTM A328, ASTM A572 or ASTM A690; with continuous interlocks.
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness as determined by design calculations, but not less than 3 inches.
- E. Lean Concrete Mix:
  1. Controlled Low Strength Material in accordance with Section 02081.
  2. A mixture of sand, fine aggregate, water and 2 sacks of cement per cubic yard to create a flowable mixture that fills voids.
  3. Minimum Compressive Strength: 1500 psi.



## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Prior to beginning installation of the excavation support system, pothole to locate existing buried utilities in the vicinity of the excavation. Survey utilities and compare actual locations to those locations indicated on the Drawings and the Shop Drawings. Determine any areas of conflict and revise the design and layout of the excavation support system to eliminate these conflicts.

### **3.02 SLOPING AND BENCHING OF EXCAVATED FACES**

- A. Where structural excavation support systems are not specifically indicated on the Drawings, sloping and benching systems for exposed faces of excavations may be utilized.
- B. Construct sloping and benching systems in accordance with Section 02300.

### **3.03 TRENCHING SUPPORT SYSTEMS**

- A. Where structural excavation support systems are not specifically indicated on the Drawings, trench support systems consisting of hydraulic jacks and plates, trench shield systems, and other trench protection systems may be utilized.

### **3.04 SOLDIER BEAMS AND LAGGING**

- A. Before starting excavation, drive steel soldier beams or install steel soldier beams in pre-drilled holes.
  - 1. Installation of Soldier Beams in Pre-Drilled Holes
    - a. Diameter of pre-drilled hole: Not to exceed the outside dimensions of the soldier beam.
    - b. Backfill around soldier beam using a lean concrete mix.
- B. Space soldier beams at regular intervals not to exceed allowable flexural strength of the wood lagging. Align exposed faces of flanges to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment.
- C. Install wood lagging within flanges of soldier beams as excavation proceeds. Trim excavation as required to install lagging.
- D. Install horizontal wales at locations indicated on the shop drawings and secure to soldier beams.
- E. Fill voids behind lagging with gravel, lean concrete or other material acceptable to the Engineer.

### **3.05 SHEET PILING**

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock to form a continuous barrier. Align exposed faces of sheet piling to vary not more than 2 inches from a horizontal line and not more than 1:120 out of vertical alignment. Cut tops of sheet piling to uniform elevation at top of excavation.

### **3.06 BRACING**

- A. Locate bracing to clear temporary and permanent work and to allow lowering of material and equipment into the excavation.

- B. If necessary to move brace, install new bracing before removing original brace.
- C. Install internal bracing when calculations indicate bracing is required to prevent spreading or distortion of braced frames.
- D. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.07 INSPECTION

- A. Designer of the shoring system is responsible for confirming proper installation of the shoring system. Shoring system designer, or a representative of the designer, shall make site visits to confirm installation is in accordance with the accepted shoring design.
- B. Submit letter of proper installation confirming installation is in accordance with the shoring design.

### 3.08 MONITORING AND STABILITY MEASUREMENTS

- A. Conduct monitoring and stability measurement in accordance with Section 02240.

### 3.09 REMOVAL

- A. Remove at least the top 10 feet of excavation support systems.
- B. Remove excavation support and protection systems when backfill can support the remaining open excavation and bear soil and hydrostatic pressures. Remove support and protection systems in stages to avoid disturbing underlying soils or damaging structures, pavements, facilities, and utilities.
- C. After removal, promptly fill voids resulting from the extraction of shoring with sand-cement grout conforming to the requirements of Section 03600. Repair or replace adjacent work damaged or displaced by excavation support and protection systems removal.

## **END OF SECTION**

## **SECTION 02300**

### **EARTHWORK**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Earthwork requirements for sitework, structures, roads and general earthwork, including excavation, fill, backfill, grading, and compaction; import of material; and disposal of surplus and unsuitable materials.
- B. Refer to Section 02320 for earthwork related to pipeline installation.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 02200 – Site Preparation
  - 3. Section 02240 – Dewatering
  - 4. Section 02260 – Excavation Support and Protection
  - 5. Section 02320 – Trenching
  - 6. Section 02722 – Aggregate Base Course Material

##### **1.03 DEFINITIONS**

- A. Backfill: Earthwork necessary to add fill between new structures and the excavation up to the sub or finish grade.
- B. Borrow Area: Area identified from which to obtain earthwork materials.
- C. Cut: Earthwork necessary to remove existing material to lower the existing grade in elevation to sub or finish grade.
- D. Embankment: Materials placed to form the subgrade for roadways or site improvements.
- E. Excavation: Earthwork necessary to remove existing material for the installation of structures.
- F. Fill: Earthwork necessary to add material to bring the existing grade up in elevation to sub or finish grade.
- G. Finish Grade: Final surface following placement of surfacing, if any, as indicated.
- H. Subgrade: The surface of the earthwork on which pavement, surfacing, base, subbase, or a layer of any other material is placed.

##### **1.04 SUBMITTALS**

- A. Prepare submittals and submit in accordance with Section 01330.
- B. Submit qualifications of the testing firm and laboratory.
- C. For imported materials, provide certification and source.

- D. For excavations 5 feet or deeper: Submit detailed plan of all shoring, bracing, side sloping, or other provisions for worker protection against the hazard of caving ground during excavations in accordance with Section 02260.

## 1.05 QUALITY ASSURANCE

- A. Materials and Compaction Testing.
  - 1. Source testing of materials: Provided and paid for by Owner.
  - 2. Field testing of compaction: Provided and paid for by Owner.
- B. Compaction Testing Standards
  - 1. In-place Density of Compacted Fill Material: Density determined in the field in accordance with ASTM D6938 – Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth).
  - 2. Maximum Dry Density of Compacted Material: determined in the laboratory in accordance with Method C of ASTM D1557-12e1 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft<sup>3</sup> (2,700 kN-m/m<sup>3</sup>)), or ASTM D4253 – Standard Test Methods for Maximum Index Density of Soils Using a Vibratory Table and D4254 – Standard Test Methods for Maximum Index Density of Soils and Calculation of Relative Density, for cohesionless, free draining soils.
- C. Material Testing Standards:
  - 1. Determination of sand equivalent value: ASTM D2419 – Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
  - 2. Liquid limit, plastic limit, and plasticity index: ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  - 3. The testing for organic matter: ASTM D2974 – Standard Test methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
- D. References in this section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D2487 – Standard Practice for Classification of Soils for Engineering Purposes. Contractor shall be bound by all applicable provisions of ASTM D2487 in the interpretation of soil classifications.

## PART 2 - PRODUCTS

### 2.01 MATERIALS

- A. General fill, backfill, and embankment materials:
  - 1. Selected or processed clean earth, rock, or sand, free from grass, roots, brush, other vegetation, corrosive and hazardous materials, manmade objects, and debris.
  - 2. Materials not defined as unsuitable as indicated below, except some materials listed as unsuitable may be used, if indicated on the Drawings or when acceptable to the Engineer, when thoroughly mixed with suitable materials to form a stable composite.
  - 3. Obtain suitable materials from one or more of the following:
    - a. Onsite excavations and designated borrow areas.

- b. Processed on-site materials.
  - c. Imported from offsite borrow areas and processing plants.
  - d. If imported materials are required by this Section, or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to Owner, unless a unit price item is included for imported materials in the Bidding Schedule.
- 4. Large rocky material: When embankment material consists of large rocky material, or hard lumps, such as hardpan or cemented gravel which cannot be broken down readily, distribute such material evenly throughout the embankment. Place sufficient earth or other fine material around the larger material as it is deposited so as to fill the interstices and produce a dense, compact embankment. Do not place rocks larger than 6 inches in diameter within the upper 2 feet of the embankment subgrade.
  - 5. Further condition fill, backfill, and embedment materials as described below or as indicated on the Drawings.

**B. Levee Berm Embankment Material:**

- 1. Lean clay, silty clay, sandy clay or gravely clay soil.
- 2. Plasticity index of 20 or less.
- 3. Liquid limit of 40 or less.
- 4. Complying with the grading shown in the following table:

Sieve Size	Percentage Passing
6-inch	100
4-inch	85-100
No. 200	30-100

**C. Structure Backfill Material (within 12" of outside face of structure)**

- 1. Granular, low to non-expansive soil.
- 2. Plasticity index 12 or less.
- 3. Liquid limit 30 or less.
- 4. Complying with the grading shown in the following table:

Sieve Size	Percentage Passing
6-inch	100
3-inch	95-100
No. 200	15-50

**D. Aggregate Base Course Material: In accordance with Section 02722.**

**E. Crushed Rock:**

- 1. Manufactured, angular, crushed stone with a minimum sand equivalent value of 75.
- 2. Clean, hard, sound, durable, uniform in quality, and free of soft, friable, thin, elongated or laminated pieces, and disintegrated material.

3. Have 100 percent of its particles with at least one fractured face on a weight basis, when tested for crushed particles per ASTM D5821.
4. Complying with the grading shown in the following table:

	Percentage Passing		
Sieve Size	1-inch	3/4-inch	1/2-inch
1-1/2-inch	100	-	-
1-inch	90-100	100	-
3/4-inch	30-60	90-100	100
1/2-inch	0-20	30-60	90-100
3/8-inch	-	0-20	20-60
No. 4	0-5	0-5	0-15
No. 8	-		0-5

F. Sand:

1. Clean, coarse, natural sand free from organic material, suitable for the purpose intended.
2. Gradation: 90 percent to 100 percent will pass a No. 4 sieve and not more than 5 percent will pass a No. 200 sieve.

## 2.02 UNSUITABLE MATERIALS

A. Unsuitable materials include the materials listed below:

1. Soils which, when classified under ASTM D2487, fall in the classifications of Pt, OH, CH, MH, or OL, or in a classification that contains Pt, OH, CH, MH, or OL in combination with any other letter designation, such as CH/CL.
2. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use, or are unstable or pump regardless of the degree of compaction.
3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.
4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the average values for existing onsite soils.
5. Topsoil, sludge and sludge-entrained soils.
6. Rocks, stones, and boulders larger than allowed for use as fill and backfill materials.

## 2.03 SOURCE QUALITY CONTROL

- A. Materials source testing will be performed by a testing laboratory by the Contractor.
- B. Minimum Frequency of sampling:
  1. Fill, backfill and embankment material generated from earthwork activities:
    - a. Two soil samples every 500 cubic yard of material used.

- b. Two soil samples whenever the character of the soil changes.
  - c. One soil sample when directed by the Engineer.
  - d. Obtain samples that represent the predominate character of the soil that is encountered.
- 2. Sampling of Imported Material
  - a. Obtain representative samples of product from supplier.
  - b. After initial testing demonstrated that the proposed borrow material meets the specified requirements, obtain and test one additional sample for every 500 cubic yard of imported material.
- C. Testing:
  - 1. Test all materials used in the Work to confirm they meet the requirements indicated.
  - 2. Prepare moisture-density curves for use in determining the optimum moisture content and in-place density of the compacted backfill.
- D. Note Used.

## **PART 3 - EXECUTION**

### **3.01 EXCAVATION – GENERAL**

- A. Excavation includes the removal of all materials of whatever nature encountered, including all obstructions of any nature.
- B. Excavation shall conform to the lines and grades indicated on the Drawings.
- C. Clear, grub and strip and remove topsoil in construction and borrow areas in accordance with Section 02200.
- D. Excavation Stability
  - 1. Slope excavated faces or otherwise support in a safe manner in accordance with applicable State safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926) and in accordance with Section 02260.
  - 2. Furnish, place, and maintain supports and shoring required to maintain stability of the sides of excavations.
- E. Notify Engineer at least 1 working day in advance of completion of any structure excavation to allow inspection of the exposed subgrade before it is covered with backfill or with any construction materials.
- F. Erosion Control:
  - 1. Maintain earthwork surfaces true and smooth and protected from erosion.
  - 2. Construct erosion control measures identified in the Storm Water Pollution Protection Plan prior to any clearing or grading activity.
- G. Control of Water: Control water entering the excavation as indicated in Section 02240.

- H. Existing Underground Utilities:
  - 1. Known existing underground utilities are generally shown on the Drawings in their approximate locations based on information of varying accuracy.
  - 2. Exercise care to avoid damage to all existing utilities whether shown or not.
  - 3. Conduct field explorations to locate all underground utilities in the vicinity of the Earthwork activities in accordance with Section 02200.
  - 4. Alert the Engineer of the presence of existing utilities that are not shown on the Drawings or are in locations different than those shown on the Drawings.
- I. Existing Overhead Utilities: There may be existing overhead utilities in the vicinity of the Work that may or may not be shown on the Drawings. Identify existing overhead utilities, if any, and use extreme caution when working in the vicinity of overhead utilities.

### 3.02 EXCAVATION FOR FILLS AND EMBANKMENTS

- A. Benching and Keyways:
  - 1. Where fill is to be placed against existing subgrade or existing grade that is sloped, excavate horizontal benches a minimum of 5 feet wide and located at vertical intervals of not more than 5 feet to provide for placement and compaction of the new fill on horizontal surfaces.
  - 2. Excavate keyway along the base of the existing slope:
    - a. Extend the keyway at least 3 feet into competent native soil.
    - b. Width of Keyway: Minimum of 15 feet.
    - c. Keyway Side Slopes: Inclined at approximately 0.75:1.
    - d. Keyway Subgrade: Scarify the upper 8-inches of the exposed surface, moisture condition and re-compact.
- B. Subgrade Preparation:
  - 1. Subgrade Beneath Embankments: Not Used
  - 2. Subgrade Beneath Paved Areas:
    - a. Excavate to the subgrade soils beneath the bottom of the aggregate base or to the subbase, if such subbase is indicated.
    - b. Scarify the top 12 inches of subgrade soils, moisture condition as necessary, and re-compact.
    - c. Finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement.
  - 3. Subgrade Beneath Structures:
    - a. Excavate to the subgrade soils beneath the bottom of the structure or bottom of crushed rock layer where indicated.
    - b. Scarify the top 12 inches of subgrade soils, moisture condition as necessary, and re-compact.



3.03 EXCAVATION IN VICINITY OF TREES (NOT USED)

3.04 OVER-EXCAVATION NOT ORDERED OR INDICATED

- A. Backfill areas over-excavated with the materials indicated for the backfill above the over-excavation or Aggregate Base.
- B. Backfill the over-excavation to restore the required subgrade elevation and compact.
- C. Any over-excavation carried below the grade indicated on the Drawings will be at no additional cost to Owner.

3.05 OVER-EXCAVATION WHERE ORDERED BY ENGINEER

- A. Where ordered by the Engineer, over-excavate beyond the depth of subgrade indicated to the dimensions ordered.
- B. Backfill areas over-excavated with the materials indicated for the backfill above the over-excavation or Aggregate Base.
- C. Backfill the over-excavation to restore the required subgrade elevation.
- D. Over-excavation less than 6 inches below the limits indicated: At no increase in cost to Owner.
- E. Over-excavation greater than 6 inches below the limits indicated: Payment will be made under separate unit price bid items for over-excavation if such bid items have been established. Otherwise, payment will be made in accordance with a negotiated price.
- F. Measurement and Payment
  - 1. Measurement of quantities for payment of over-excavation: By calculation by Engineer of the volume of materials removed as over-excavation based on the difference between the excavation dimensions before and after the over-excavation work. No compensation will be made for removal of materials beyond the limits of the additional excavation ordered by Engineer or for materials which may come into the excavation from outside the designated limits. No compensation will be made for removal of materials that are outside of the minimum horizontal dimensions indicated.
  - 2. Payment for over-excavation will be made by the cubic yard. The payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in excavating and backfilling the over-excavation completely. Payment shall also include full compensation for the removal and disposal of the excavated materials, import and installation of backfill materials, control of water in the excavation, excavation support, and all costs associated with interruption of construction operations during the review of the foundations, over-excavation, backfill, and all other operations required for, or as a result of, over-excavation.

3.06 ROCK EXCAVATION (NOT USED)

3.07 DISPOSAL OF UNSUITABLE, EXCESS EXCAVATED AND OTHER MATERIALS

- A. Dispose unsuitable or excess excavated materials at an appropriate site selected by Contractor unless otherwise indicated.

- B. Obtain required permits, landowner, and agency approvals for disposal of unsuitable and excess excavated materials and pay costs associated with the removal and disposal of the materials.

### 3.08 FILL AND EMBANKMENT CONSTRUCTION

- A. Scarify foundation soils for fills and embankments bring to optimum moisture content, and re-compact with heavy compaction equipment to obtain compaction indicated.
- B. Place and compact fill and embankments in horizontal layers so that when compacted layers to not exceed thickness indicated.
- C. Provide keyways or benches where an embankment or fill is to be placed against slopes, hillsides, or fill slopes.
- D. Slopes: Construct slopes as indicated except construct no permanent fill or embankment slopes with slope inclinations that exceed 2:1 (horizontal:vertical) unless specifically indicated otherwise
- E. Over-construct fills and embankments to greater horizontal dimensions than indicated. Cut back slope following placement and compaction to expose well compacted fill.
- F. Construct the first 3 feet of embankment or fills over pipelines using placement and compaction equipment that do not damage the pipe. Keep heavy construction equipment a minimum distance of the edge of the trench equal to the depth of the trench until at least 3 feet of fill over the pipe has been completed.

### 3.09 LEVEE EMBANKMENT CONSTRUCTION (NOT USED)

### 3.10 STRUCTURE BACKFILL

- A. Provide Structure Backfill material within 12-inches of all structures to be backfilled unless otherwise indicated.
- B. Place a 6-inch layer of 3/4-inch or 1-inch Crushed Rock below all structures, unless otherwise indicated.
- C. Do not drop backfill upon any structure or pipe.
- D. Confirm concrete structures have attained sufficient strength to withstand the backfill loads imposed.
- E. Do not place backfill around water retaining structures until structures have been tested and approved for backfill. Fill structures with water during backfill operations.
- F. Place backfill after all water has been removed from the excavation and the excavation sidewalls and subgrade soils have dried to a moisture content suitable for compaction.
- G. Remove all loose, sloughing, or caving soils and rock materials prior to placement of backfill.
- H. Place geotextile fabric as indicated.
- I. Promptly after removal, fill voids created by the extraction of sheetpile or shoring indicated in Section 02260.
- J. Place backfill and spread evenly in layers so that when compacted layers do not exceed thickness indicated.
- K. Thoroughly mix layers as necessary to promote uniformity of material in each layer.

- L. Add water to backfill material where moisture content is below the optimum moisture content and mix with the soil until the proper moisture content is achieved throughout the soil layer.
- M. Where backfill material moisture content is too high to permit the specified degree of compaction, dry backfill material until moisture content is satisfactory.

### 3.11 COMPACTION OF FILL, BACKFILL, AND EMBANKMENT MATERIALS

- A. Adjust moisture condition of soils to achieve a water content of 3 percent, plus or minus 0.5 percent, above the optimum moisture content as determined through laboratory testing of the soil.
- B. Compact each layer in a uniform and systematic manner.
- C. For materials with less than 10 percent passing the No. 4 sieve, compact by means of at least 2 passes from a flat plate vibratory compactor.
- D. For materials with 10 percent or more passing the No. 4 sieve, mechanically compact to the indicated percentage of density each layer of backfill materials.
  - 1. Use equipment that is consistently capable of achieving the required degree of compaction.
  - 2. Compact each layer over its entire area while the material is at the required moisture content.
- E. Do not use flooding, ponding, or jetting as a method of compaction.
- F. Do not use equipment weighing more than 10,000 lbs closer to structure walls than a horizontal distance equal to the depth of the fill at the time. Use hand operated power compaction equipment where use of heavier equipment is impractical or restricted due to weight limitations.
- G. Compaction Requirements:
  - 1. Where agency or utility company requirements govern, the highest compaction standards shall apply.
  - 2. Compact finish and subgrades in compliance with the following table:
  - 3.

Location or Use of Fill	Limit/Layer Thickness	Percentage of Maximum Dry Density of Compacted Material per ASTM D1557
Backfill around structures	8 in. Layers	90
Embankment Fill	12 in. Layers	90
Subgrade beneath embankments or fill areas (upper 8 inches)	Upper 12 in.	95
Subgrade beneath paved areas (upper 12 inches)	Upper 12 in.	95
Subgrade beneath structures (upper 12 inches)	Upper 12 in.	95
Subgrade beneath keyway (upper 8 inches)	Upper 8 in.	95
Finish grade in unimproved or landscape areas	Upper 12 in.	85

### 3.12 FIELD QUALITY CONTROL AND TESTING

- A. Field quality control testing for compaction confirmation will be done by a testing laboratory selected by the Contractor and approved by the Owner.
- B. If requested by the Owner, remove soil above the level at which the Owner wishes tests to be completed. Backfill and re-compact material after testing is completed.
- C. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
  - 1. Remove and replace backfill at proper density.
  - 2. Bring density up to specified level by other means acceptable to Owner.
  - 3. Retesting:
    - a. Costs for conducting additional tests to confirm and verify that remedial work has brought compaction within specified requirements shall be borne by the Contractor.
    - b. Conduct compaction tests at twice as frequently specified for the initial confirmation tests.
- D. Where soil compaction is specified as a percentage of maximum dry density, determine the maximum dry density at optimum moisture content by laboratory testing in accordance with Method C of ASTM D1557.
- E. Where compaction of cohesionless, free draining soil is specified as a percentage of relative density, determine relative density by laboratory testing in accordance with ASTM D4253 and D4254.
- F. Determine In-Place Density of Compacted Fill Material by performing field tests of soil density in accordance with ASTM D6938.
- G. Frequency of Compaction Confirmation Testing at intervals not less than as follows:
  - 1. Embankments and Fills: 2 tests every 500 cubic yards.
  - 2. Structure Backfill: 1 test every 5 feet in elevation per 100 horizontal feet of backfill.

### 3.13 FINISH GRADES

- A. Surface: Reasonably smooth and free of grade breaks, irregular surface changes, protrusions and other defects.
- B. Restore un-improved areas back to pre-construction grades.
- C. Backfill topsoil in all areas where the topsoil was removed as part of the site preparation.
- D. Restore drainage swales and water courses to their pre-construction alignments and grades unless otherwise modified by the Work. Grade surface to drain away from structures. Direct drainage to collection points.
- E. Provide smooth transitions to existing grades.
- F. Repair and reestablish grades to required elevations and slopes due to any settlement or erosion that may occur prior to final acceptance.
- G. Vertical Tolerance:

1. Subgrade under paved areas: 0.0 feet above and 0.08 feet below.
2. Subgrade under structures: 0.0 feet above and 0.08 feet below.
3. Landscaped areas: 0.1 feet above and 0.1 feet below.
4. Unimproved areas: 0.1 feet above and 0.1 feet below.

**END OF SECTION**

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## **SECTION 02320**

### **TRENCHING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

1. Trench excavation and backfilling for pipe and pipeline appurtenances.
2. Minor structure excavation and backfill associated with pipeline construction.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  1. Section 01140 – Work Sequence and Constraints
  2. Section 01330 – Submittals
  3. Section 02071 – Geotextile Fabric
  4. Section 02081 – Controlled Low Strength Material
  5. Section 02200 – Site Preparation
  6. Section 02210 – Subsurface Investigations
  7. Section 02240 – Dewatering
  8. Section 02260 – Excavation Support and Protection
  9. Section 02722 – Aggregate Base Course Material
  10. Section 02953 – Pavement Restoration
  11. Section 03301 – Cast-in-Place Concrete
  12. Section 03600 – Grout

##### **1.03 DEFINITIONS**

- A. Backfill: Earthwork necessary to provide fill between new structures and excavation up to the sub or finish grade.
- B. Bedding Zone: The area from the trench subgrade to the bottom of the pipe.
- C. Embedment or Pipe Zone: The area from the top of the Bedding Zone to the bottom of the Trench Zone as indicated on the Drawings.
- D. Excavation: Earthwork necessary to remove existing material for the installation of structures.
- E. Finish Grade: Final surface following placement of surfacing, if any, as indicated.
- F. Native Material: Naturally occurring soils excavated from the trench after top soil, if any, has been removed.
- G. Open Areas: Areas along the pipeline route that are outside Roadway Shoulders or in open pasture.

- H. Pavement Section: The upper portion of the trench within paved areas comprising the base and finished surface materials.
- I. Roadway Shoulders: Paved areas and unpaved areas outside the traveled way and extending to the outside edge of any roadside drainage features.
- J. Spoils: Unsuitable or excess excavated materials.
- K. Subgrade: The surface of the earthwork on which bedding, base materials, pavement, other surfacing materials, or structure bases are placed.
- L. Traveled Way: The portion of the roadway where vehicles travel, does not include shoulders.
- M. Trench Backfill: Materials used to backfill the trench including bedding zone, pipe zone, and trench zone backfill.
- N. Trench Zone: The area from the top of the Pipe Zone to the bottom of the pavement base (subgrade), ground surface or other surface material over the trench excavation.
- O. Wet Trench: Trench with water or groundwater present in the trench.

#### 1.04 SUBMITTALS

- A. Prepare submittals and submit in accordance with Section 01330.
- B. Material Data: Submit the following for each material type imported to the site:
  - 1. Material source.
  - 2. Gradation.
  - 3. Moisture-density curves.
  - 4. Permeability tests (for clay material).
- C. All material submittals must be dated to less than 1 year prior to Notice-to-proceed.
- D. For excavations 5 feet or deeper, submit detailed plan of all shoring, bracing, side sloping, or other provisions for worker protection against the hazard of caving ground during excavations in accordance with Section 02260.
- E. Submit name and qualifications of materials testing lab for Contractor furnished testing.

#### 1.05 QUALITY ASSURANCE

- A. Materials and compaction testing
  - 1. Source Testing of Materials: Provided and paid for by Contractor.
  - 2. Field Testing of Compaction: Provided and paid for by Contractor.
  - 3. For contractor provided testing, provide testing performed by a qualified testing laboratory approved by the Owner. Submit testing laboratory qualifications for approval.
- B. Compaction Testing:
  - 1. In-place Density Testing of Compacted Fill Material: ASTM D6938 – Test Methods for Density of Soil and Soil Aggregate by Nuclear Methods (shallow depth).



2. Maximum Dry Density:
  - a. Cohesive soils: Method C of ASTM D1557 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb Rammer and 18” Drop.
  - b. Cohesionless, free draining soils: ASTM D4253 – Test Methods for Maximum Index Density of Soils Using a Vibratory Table and D4254 – Test Methods for Maximum Index Density of Soils and Calculation of Relative Density.
- C. Materials Testing Standards:
  1. Particle size analysis of soils and aggregates: ASTM D422 – Method for Particle-Size Analysis of Soils.
  2. Determination of sand equivalent value: ASTM D2419 – Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
  3. Liquid limit, plastic limit, and plasticity index: ASTM D4318 – Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
  4. Testing for organic matter: ASTM D2974 – Standard Test methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils.
  5. Testing for percentage of fractured particles: ASTM D5821.
  6. References in this section to soil classification types and standards: Meanings and definitions indicated in ASTM D2487 – Classification of Soils for Engineering Purposes.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. General:
  1. Obtain trench backfill materials from one or more of the following:
    - a. Processed on-site materials,
    - b. Imported from off-site borrow areas,
    - c. Processing plants.
  2. Provide materials as indicated or as may be necessary to complete the Work at no additional cost to the Owner, unless a unit price item is included for trench backfill materials in the bidding schedule.
  3. Provide materials as indicated in the Schedule in PART 3.
  4. Soils unsuitable for use as trench backfill materials:
    - a. Soils classified under ASTM D2487 categories Pt, OH, CH, MH, or OL; or soils that contain classifications Pt, OH, CH, MH, or OL in combination with any other soil classification, such as CH/CL.
    - b. Soils which cannot be compacted sufficiently to achieve the density specified for the intended use, are highly expansive, or are unstable or "pump", regardless of the degree of compaction.

- c. Soils that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable Regulations.
- d. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing on-site soils.
- e. Topsoil, except as allowed below.
- f. Soils containing rocks, stones, or boulders larger than specified.
- g. Soils that contain more than 5 percent organic matter when tested in accordance with ASTM D2974.

B. Native Materials:

- 1. Materials generated from on-site materials conditioned as follows:
  - a. Maximum particle size: 3 inches.
  - b. Percent passing No. 200 sieve: Less than 5 percent.
  - c. Sand equivalent: 30 minimum.

C. Crushed Rock:

- 1. Clean, hard, sound, durable, uniform in quality, and free of soft, friable, thin, elongated or laminated pieces, and disintegrated material.
- 2. Have 100 percent of its particles with at least one fractured face on a weight basis, when tested for crushed particles per ASTM D5821.
- 3. Comply with the grading shown in the following table:

Sieve Size	Percentage Passing		
	1-inch	3/4inch	1/2-inch
1-1/2-inch	100	-	-
1-inch	90-100	100	-
3/4-inch	30-60	90-100	100
1/2-inch	0-20	30-60	90-100
3/8-inch	-	0-20	20-60
No. 4	0-5	0-5	0-15
No. 8	-		0-5

D. Sand:

- 1. General: Clean, coarse, natural sand free from organic material, suitable for the purpose intended.
- 2. Gradation: 90 percent to 100 percent will pass a No. 4 sieve and not more than 5 percent will pass a No. 200 sieve.

E. Controlled Low Strength Material (CLSM): In accordance with Section 02081.

F. Aggregate Base: Class 2 aggregated base as specified in Section 02722.

G. Clay:

- 1. On-site or off-site clay material free of organic materials or rocks.

2. Permeability: Not greater than  $1 \times 10^{-6}$  cm/sec when tested in accordance with ASTM D2434.

H. Permeable Backfill:

1. General: Hard, durable, clean sand, gravel or crushed stone, free from organic material, clay balls or other deleterious substances.
2. Durability index: Not less than 40
3. Sand equivalent: Not less than 75.
4. Comply with the grading shown in the following table:

Sieve Sizes, Square Openings	Percent by Weight Passing Sieve
1-inch	100
3/4-inch	90 – 100
3/8"	40 – 100
No. 4	25 – 40
No. 8	18 – 33
No. 30	5 – 15
No. 50	0 – 7
No. 200	0 – 3

I. Filter Fabric: In accordance with Section 02071.

J. Structure Backfill Material:

1. General: Granular, low to non-expansive soil.
2. Plasticity index: 12 or less.
3. Liquid limit: 30 or less.
4. Comply with the grading shown in the following table:

Sieve Size	Percentage Passing
6-inch	100
3-inch	95-100
No. 200	15-50

K. Concrete: In accordance with Section 03301

L. Cement Slurry Backfill:

1. Slurry cement backfill: Provide a fluid workable mixture of aggregate, cement, and water.
2. Cement: In accordance with Section 03301, except testing is not required.
3. Water: Free from oil, salts, and other impurities that adversely affect the backfill.
4. Aggregates: Select one of the following:

- a. Commercial-quality concrete sand
- b. Excavated or imported material in any combination, free of organic material and other deleterious substances and complying with the grading requirements shown in the following table:

Sieve size	Percentage passing
1-1/2"	100
1"	80–100
3/4"	60–100
3/8"	50–100
No. 4	40–80
No. 100	10–40

5. Proportion slurry cement backfill by weight or volume. Use at least 188 pounds of cement per cubic yard. Use sufficient water to produce a fluid workable mix that flows and can be pumped without segregation during placement.
6. Mix materials thoroughly by machine. Use a pugmill, rotary drum, or other authorized mixer. Mix until cement and water are thoroughly dispersed.

## 2.02 SOURCE QUALITY CONTROL

- A. Perform source quality control testing by approved testing laboratory and submit results to Owner.
- B. Frequency of Sampling of Imported Material: After initial testing demonstrates that the proposed borrow material meets the specified requirements, obtain and submit one additional sample for every 500 cubic yards of imported material.

## PART 3 - EXECUTION

### 3.01 EXISTING UTILITY LOCATIONS

- A. Perform subsurface investigations to locate existing underground utilities in accordance with Section 02210.

### 3.02 REMOVAL AND REPLACEMENT OF PAVEMENT

- A. In paved areas, remove and replace pavement as follows unless otherwise indicated:
  1. Saw cut existing pavement along each side of the trench.
  2. Remove and dispose of the pavement lying within the limits of the saw cuts and from adjoining areas damaged by the cutting, removal, excavation and backfilling operations.
  3. During subsequent trench excavation and backfill activities, minimize disturbance of the adjoining pavement.
  4. Restore pavement surfaces in accordance with Section 02953.
  5. Refer to drawings and Section 01140 for additional pavement removal and replacement requirements.

### 3.03 TRENCH EXCAVATION

#### A. General Requirements

1. Stabilize and support all faces of the trench excavation as specified in Section 02260.
2. Control groundwater as specified in Section 02240.
3. Clear, grub, and strip construction area as necessary to remove all vegetation and top soil as specified in Section 02200.

#### B. Open Trenches

1. Open Trench Limitations: Unless otherwise indicated or required by the Agency having jurisdiction limit open trenches as follows:
2. Travelled Way plus 3 feet either side:
  - a. Do not open more than 100 lineal feet of excavated trench at any one time during the Work shift.
  - b. Up to 25 feet of trench as measured at the surface may remain open during any non-work shift, provided:
    - 1) The entire trench opening is plated with steel plates, secured to avoid movement, and the edges backfilled with temporary pavement to provide a smooth transition.
    - 2) Shoring is installed to prevent collapse of the trench excavation.
3. Paved surfaces including road shoulders:
  - a. Do not open more than 100 lineal feet of excavated trench at any one time during the Work shift.
  - b. Up to 25 feet of trench as measured at the surface may remain open during any non-work shift provided the open trench is adequately plated, and the trench adequately shored.
4. Open areas: Do not open more than 100 lineal feet of excavated trench at one time.
5. Open Trench Safety Requirements:
  - a. Provide fencing or warning tape to protect the public from open trench in open areas.

#### C. Trench Excavations

1. Excavate trenches and maintain excavation such that pipe and pipeline accessories are installed in an open trench.
2. Excavate to subgrade elevation and to trench width dimensions indicated on the Drawings.
3. Excavate all materials of whatever nature encountered, including all obstructions of any nature that would interfere with the proper execution of the trenching Work unless otherwise indicated.
4. Where pipelines are to be installed in embankments, fills, or structure backfills, construct fill to a level at least one foot above the top of the pipe before the trench is excavated.

5. Trench shield:
  - a. If a moveable trench shield is used during excavation operations widen the trench width so that the shield is free to be lifted and then moved longitudinally without binding against the trench sidewalls.
  - b. If the trench walls cave in or slough, the trench shall be excavated as an open cut excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.
- D. Trench Bottom: Excavate and shape trench bottoms to provide uniform subgrade for placement of Bedding Material.
  1. Unsuitable Hard Trench Bottom: If bottom of excavation is found to consist of rock or any material that cannot be excavated to provide uniform bearing surface:
    - a. Notify Engineer of the conditions encountered and obtain concurrence that an unsuitable trench bottom condition is present.
    - b. Remove such rock or other material to a depth of not less than 3 inches below the original design elevation of the bottom of the trench.
    - c. Place bedding material or aggregate base course material to restore the trench bottom to the original design elevation. Place in lifts not exceeding 8 inches in un-compacted thickness and compact to 90 percent of maximum dry density.
  2. Unsuitable Soft Trench Bottom: If bottom of excavation is found to consist of soft or unstable material which is incapable of properly supporting pipe:
    - a. Notify Engineer of the condition encountered and obtain concurrence that an unsuitable trench bottom condition is present.
    - b. Remove such material to a depth and for the length required, as determined by the Engineer.
    - c. Place bedding material or aggregate base course material to restore the trench bottom to the original design elevation. Place in lifts not exceeding 8 inches in un-compacted thickness and compact to 90 percent of maximum dry density.
  3. Over-excavation
    - a. Over-excavation to a depth 6 inches or less below the design trench bottom shall be done at no additional cost to the Owner.
    - b. When the over-excavation ordered by Engineer is greater than 6 inches below the limits shown, additional payment will be made to Contractor. Additional payment will be made under separate unit price bid items for over-excavation if such bid items have been established. Otherwise, payment will be made in accordance with a negotiated price.
    - c. Measurement and Payment:
      - 1) Measurement of quantities for payment of over-excavation will be by calculation by Engineer of the volume of materials removed as additional excavation, including additional material that must be excavated from slopes. Such calculation shall be based on the difference between dimensions before and after the additional excavation work. No compensation will be made for removal of materials beyond the limits of the additional excavation ordered by Engineer or for materials which may come into the excavation

from outside the designated limits. No compensation will be made for removal of materials that are outside of the minimum horizontal dimensions indicated, even if Contractor has excavated wider than the minimum indicated.

- 2) Payment for over-excavation will be made by the cubic yard. The payment shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in excavating and backfilling the over-excavation completely, to a level at the bottom of the pipe bedding indicated. Payment shall also include full compensation for the removal and disposal of the excavated materials, import and installation of the backfill materials, control of water in the excavation, excavation support, and all costs associated with the interruption of construction operations during the review of the foundations, excavation, backfill, and all other operations required for, or as a result of, over-excavation.

4. Over-excavation not ordered by the Engineer:

- a. Any over-excavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed by Contractor at no additional cost to Owner.

3.04 EXCAVATION FOR MANHOLES, VAULTS AND OTHER PIPELINE STRUCTURES

- A. Unless otherwise indicated, provide excavations sufficient to leave at least 12 inches clear between structure outer surfaces and the face of the excavation or any shoring which may be used to support the face of the excavation.
- B. Excavate to the subgrade soils beneath the bottom of the structure or bottom of crushed rock layer where indicated.
- C. Scarify the top subgrade soils to a depth of 6 inches, moisture condition, and re-compact to 90 percent of maximum dry density.

3.05 EXCAVATION IN VICINITY OF TREES (NOT USED)

3.06 ROCK EXCAVATION (NOT USED)

3.07 WARNING TAPE INSTALLATION

- A. Install warning tape and tracer wire as indicated.
- B. Install warning tape centered on the pipe one (1) foot above the pipe unless otherwise indicated.
- C. Overlap warning tape ends a minimum of twelve (12) inches.

3.08 TRACER WIRE INSTALLATION

- A. Install tracer wire on all pipe unless otherwise indicated.
- B. Install tracer wire to form an electrically continuous line.
- C. Secure tracer wire to the top center of the pipe at a minimum interval of 5 feet and at each change in direction.

- D. Extend the tracer wire to the surface at valve boxes, hydrants, blow-off valves, air valves and other appurtenances and loop back to the pipeline such that there is a continuous wire from end to end. Provide 12 inch pigtail in the valve or appurtenance box and 12 inch pigtail adjacent to the base of hydrants.
- E. Provide 12 inch pigtail at the termination of each run of pipe included in the project. Where there is no appurtenance to be provided, install a valve box to contain the pigtail.

### 3.09 BEDDING ZONE

- A. Bedding Material: As scheduled herein or as indicated on the Drawings
- B. Depth of Bedding Material: As indicated on the Drawings.
- C. Place Bedding Material in a single lift, and at uniform density, with minimum possible compaction. Grade material to allow installation of the pipe at the design elevations.
- D. Depressions for Assembly of Joints
  - 1. Dig holes for bell or coupling assembly after Bedding Material has been placed at the trench bottom and fine graded to the design elevation.
  - 2. Create sufficient width and depth to provide ample room for tightening bolts, welding, or other joint assembly activities.
  - 3. Excavate holes only as necessary in making joints. Ensure that pipe rests upon prepared trench bottom and is not supported by any portion of the joint.

### 3.10 PIPE ZONE

- A. Pipe Zone Material: As scheduled herein or as indicated on the Drawings.
- B. Dimensions of Pipe Zone Material: As indicated on the Drawings.
- C. After the pipe is laid, place material within the Pipe Zone in lifts:
  - 1. Place backfill only after all water is removed from the excavation and the trench sidewalls have been dried to a moisture content suitable for compaction.
  - 2. Immediately prior to placing backfill materials remove all loose, sloughing, or caving soils and rock materials from the trench.
  - 3. Place in lifts not exceeding 8 inches in un-compacted thickness and compact to 90 percent of maximum dry density. Maintain level backfill on each side of pipe.
  - 4. Do not dump backfill materials directly on the pipe.
- D. Pipe Displacement
  - 1. Take necessary precautions in placement and compaction of to prevent displacement of piping.
  - 2. In the event there is movement of the pipe, excavate and re-lay the pipe.
- E. Consolidation:
  - 1. Do not use water-settling methods to consolidate trench backfill materials.
  - 2. Use mechanical means, shovel slicing or vibratory compaction, to compact granular backfill materials under pipe haunches.



### 3.11 TRENCH ZONE

- A. Trench Zone Material: As scheduled herein or as indicated on the Drawings.
- B. Dimensions of Trench Zone Material: As indicated on the Drawings
- C. Backfill voids that may form when removing shoring and bracing.
- D. Do not use water-settling methods to consolidate Trench Zone Material.
- E. Under Existing Crossing Pipes or Conduits Larger than 3 Inches in Diameter
  - 1. Backfill from the top of the Pipe Zone to the spring line of the intersecting pipe or conduit with Aggregate Base or Pipe Zone material. Place in lifts not exceeding 8 inches in compacted depth and compact to 90 percent of maximum dry density.
  - 2. Extend Pipe Zone material 2 feet on either side of crossing pipe or conduit to 6 inches above the top of the crossing pipe.
  - 3. Backfill remainder of trench as described in this Section.

### 3.12 FINAL BACKFILL ZONE

- A. Unless indicated otherwise on the Drawings, restore the Site to the topography that existed prior to construction by excavation, compaction, finish grading and other earthwork operations, as necessary, for the areas affected by construction.
- B. Backfill with stockpiled topsoil in all areas where the original topsoil was removed as part of the site preparation and construction activities.
- C. Restore all drainage swales and water courses to their original alignments and grades.
- D. Install and maintain for a period of at least one year following completion of construction in any area, the facilities and management practices required by the Project Storm Water Pollution Prevention Plan, if any.
- E. Install and maintain for a period of at least one year following completion of construction in any area, the measures required by the environmental permitting Drawings, permits, and approval documents of the agencies that have issued permits for construction of the Project.
- F. Inside road rights-of-way:
  - 1. Unless otherwise indicated on the Drawings or required by the agency having jurisdiction of the road right-of-way, complete trench backfill as follows:
    - a. Place in lifts not exceeding 6 inches in un-compacted depth.
    - b. Compact to 90 percent of maximum dry density except compact to 95 percent the upper 24 inches below the finished grade.
    - c. Replace aggregate base course to match existing aggregate base course thickness.
    - d. Replace final surface as indicated on the Drawings, match existing thickness, or as required by the agency having jurisdiction of the right-of-way, whichever is greater.
- G. Outside road rights-of-way:
  - 1. Areas with unpaved surfaces:
    - a. Place final backfill in lifts not exceeding 18 inches in un-compacted depth and compact to 85 percent of maximum dry density.

- b. In Open Areas, replace topsoil with material that was removed and stockpiled prior to trench excavation.
- 2. Paved areas or driveways:
  - a. Backfill in lifts not exceeding 12-inches in un-compacted depth and compact to 90 percent maximum dry density except compact the upper 12 inches to 95 percent.
  - b. Replace final surface as indicated on the Drawings or match existing thickness, whichever is greater.
  - c. Replace driveway materials in kind.
  - d. Match pre-construction condition or better.
  - e. Smooth and compact material as required to create a smooth and firm driving surface.

### 3.13 CONCRETE PIPE ENCASEMENT

- A. Provide concrete pipe encasement where indicated on the Drawings.
- B. Concrete: 2,000 psi
- C. Provide temporary bulkheads to contain concrete at each end of encasement. Remove temporary bulkheads after concrete has set.
- D. Install reinforcing steel, where indicated, in accordance with Section 03301.
- E. Mix and place concrete in accordance with Section 03301
- F. Control placement of concrete to prevent movement of the pipe from either displacement or buoyancy forces.
- G. Support pipeline on concrete blocks, sand bags, or pre-mixed cement bags unless otherwise noted. Place supports a minimum of 10 feet on center.
- H. Maintain groundwater removal, as necessary, at least until completion of concrete placement.
- I. Do not place backfill on top of concrete within 4 hours of the completion of concrete placement.

### 3.14 CEMENT SLURRY BACKFILL

- A. Provide cement slurry backfill where indicated on the Drawings.
- B. Provide temporary bulkheads to contain cement slurry at each end of cement slurry backfill segments. Remove temporary bulkheads after slurry has set.
- C. Control placement of cement slurry backfill to prevent movement of the pipe from either displacement or buoyancy forces.
- D. Support pipeline on concrete blocks, sand bags, or pre-mixed cement bags unless otherwise noted. Place supports a minimum of 10 feet on center.
- E. Maintain groundwater removal, as necessary, at least until completion of cement slurry backfill placement.
- F. Do not place backfill on top of cement slurry backfill within 4 hours of the completion of cement slurry backfill placement.

### 3.15 TRENCH DAMS

- A. Trench dam material: As scheduled herein or as indicated on the Drawings.
- B. Dimensions of trench dams: As indicated on the Drawings
- C. Location of trench dams: As indicated on the Drawings.
- D. Trench dams are not required if controlled low strength material (CLSM) backfill is used.

### 3.16 STRUCTURE BACKFILL

- A. Provide Structure Backfill material within 12-inches of all structures to be backfilled unless otherwise indicated.
- B. Place a 6-inch layer of 3/4-inch or 1-inch Crushed Rock below all structures, unless otherwise indicated.
- C. Do not drop backfill upon any structure or pipe.
- D. Confirm concrete structures have attained sufficient strength to withstand the backfill loads imposed prior to placing backfill.
- E. Do not place backfill around water retaining structures until structures have been tested and approved for backfill. Fill structures with water during backfill operations.
- F. Place backfill after all water has been removed from the excavation and the excavation sidewalls and subgrade soils have dried to a moisture content suitable for compaction.
- G. Remove all loose, sloughing, or caving soils and rock materials prior to placement of backfill.
- H. Place geotextile fabric as indicated.
- I. Promptly after removal, fill voids created by the extraction of sheetpile or shoring with sand-cement grout that conforms to Section 03600.
- J. Place backfill and spread evenly in layers so that when compacted layers do not exceed thickness indicated.
- K. Thoroughly mix layers as necessary to promote uniformity of material in each layer.
- L. Add water to backfill material where moisture content is below the optimum moisture content and mix with the soil until the proper moisture content is achieved throughout the soil layer.
- M. Compact backfill to 90 percent of maximum dry density except compact to 95 percent the upper 24 inches below the finished grade.

### 3.17 COMPACTION REQUIREMENTS

- A. Compaction requirements specified herein are in-place densities of compacted backfill.
- B. Initial Trench Backfill Compaction Demonstration
  - 1. Demonstrate adequacy of compaction equipment and procedures before exceeding 500 lineal feet of trenching work.
  - 2. Continued Compaction Requirements: When specified degree of compaction is achieved, proceed with trenching and backfilling activities using the established equipment and procedures.

### 3.18 DISPOSAL OF SPOILS

- A. Dispose of spoils and unsuitable materials in a lawful manner at an off-site location.
- B. Do not dispose of spoils within temporary or permanent easements.
- C. A spoils disposal area has not been identified for this project. It is Contractor's responsibility to identify spoils disposal areas and to negotiate all agreements necessary and pay all costs to dispose of spoils.
- D. Obtain written permission and landowner agreements that allows the disposal of spoils and contains language that states that Owner, Engineer, and Design Consultant shall not be liable for any claims or damages resulting from Contractor's use of properties for disposal of spoils.
- E. Prior to removal of any materials from the project site, provide copies of permits, landowner agreements, and approvals to Engineer.

### 3.19 FIELD QUALITY CONTROL

- A. Cost of compliance testing: By Contractor.
- B. Frequency of testing: Periodic compliance tests may be made by the Engineer to verify that compaction is meeting requirements specified.
- C. Contractor's responsibilities:
  - 1. Coordinate compaction testing and compliance with agency having jurisdiction over the Work within the public right-of-way.
  - 2. Submit copies to the Owner of compaction testing results for compaction testing conducted by others.
  - 3. Remove overburden above level at which the Engineer wishes to test.
  - 4. Provide trench support and groundwater removal.
  - 5. Backfill and re-compact material after testing is completed.
  - 6. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
    - a. Remove and replace backfill at proper density.
    - b. Bring density up to specified level by other means acceptable to the Engineer.
    - c. Redo trench backfill compaction demonstration and demonstrate compaction process achieves required results.
    - d. Costs of retesting to confirm compliance: By the Contractor.
- D. Compaction Testing: Contractor Furnished:
  - 1. Coordinate compaction testing and compliance with agency having jurisdiction over the Work within the public right-of-way.
  - 2. Submit copies of compaction testing results to the Owner.
  - 3. If compaction fails to meet specified requirements, perform remedial work by one of the following methods:
    - a. Remove and replace backfill at proper density.

- b. Bring density up to specified level by other means acceptable to the Engineer.
    - c. Redo trench backfill compaction demonstration and demonstrate compaction process achieves required results.
- E. Frequency of trench backfill compaction confirmation testing:
  - 1. Each test location: Perform tests for each type or class of backfill from bedding to finish grade, excluding controlled low strength material (CLSM) and concrete slurry backfill
  - 2. Open fields: 1 tests every 1,000 linear feet.
  - 3. Non-paved roadways: 1 tests every 500 linear feet.
  - 4. Crossing paved roadways: 2 tests at each crossing.
  - 5. Inside road rights-of-way:
    - a. 1 test every 300 linear feet.
    - b. As required by the Agency having jurisdiction over the right-of-way.

### 3.20 SCHEDULE

- A. Construct pipeline using materials specified in the following schedule. Where options are provided, Contractor may select materials from the materials listed.
  - 1. Bedding Zone:
    - a. Crushed Rock (3/4")
    - b. Sand
    - c. Controlled Low Strength Material
  - 2. Wet Trench:
    - a. Crushed Rock (3/4") wrapped with filter fabric
  - 3. Embedment Zone:
    - a. Crushed Rock (3/4")
    - b. Controlled Low Strength Material
  - 4. Trench Zone:
    - a. Native Backfill, except Class 2 Aggregate Base within 36-inches of the finished surface within paved areas.
    - b. Class 2 Aggregate Base
  - 5. Trench dams materials:
    - a. Clay
    - b. Controlled Low Strength Material
    - c. Two Sack Cement Slurry
- B. Structure Backfill:
  - 1. Bedding:
    - a. Crushed Rock (1- or 3/4-inch)
    - b. Class 2 Aggregate Base.

2. Structure backfill:
  - a. Structure Backfill Material
  - b. Class 2 Aggregate Base.

**END OF SECTION**

## **SECTION 02722**

### **AGGREGATE BASE COURSE MATERIAL**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Aggregate base course material and placement.

##### **1.02 DEFINITIONS**

- A. Completed Course: Compacted, unyielding, free from irregularities, with smooth, tight, even surface, true to grade, line, and cross-section.
- B. Completed Lift: Compacted with uniform surface reasonably true to cross-section.

##### **1.03 STANDARD SPECIFICATION**

- A. Oregon Standard Specifications for Construction (OSSC), 2018 edition.

##### **1.04 SUBMITTALS**

- A. Product Data: Source, gradation, and testing data records for aggregate base course material previously produced by the supplier, which demonstrates compliance with the specified gradation and physical requirements.

##### **1.05 DELIVERY, STORAGE AND HANDLING**

- A. Storage and Protection: Protect from segregation and excessive moisture during delivery, storage, and handling.

##### **1.06 QUALITY ASSURANCE**

- A. Material and Compaction Testing
  - 1. Source Testing of Materials: Provided and paid for by the Contractor.
  - 2. Field Testing for Compaction: Provided and paid for by the Contractor.
- B. Compaction Testing
  - 1. In-place Density: Density of aggregate base course material that has been placed and compacted in the field, then tested in conformance with ASTM D2922 and ASTM D3017 to determine density relative to the maximum density.
  - 2. Maximum Density: Density obtained in the laboratory when tested in accordance with ASTM D1557.

#### **PART 2 - PRODUCTS**

##### **2.01 MATERIALS**

- A. Aggregate: Dense-graded consisting of crushed rock, hard, durable particles or fragments of stone or gravel, screened or crushed to the specified grading and free from vegetable matter, lumps or balls of clay, alkali, adobe, or other deleterious matter.

- B. Use either 1-1/2"-0 or 3/4"-0 aggregate grading unless otherwise indicated. Do not change grading without authorization from the Engineer.
- C. Conform to the following gradation when tested in accordance with AASHTO T27:

Sieve Sizes (Square Openings)	Percent by Weight Passing Sieve 3/4" Maximum	Percent by Weight Passing Sieve 1-1/2" Maximum
2"	-	100
1-1/2"	-	95-100
1-inch	100	-
3/4-inch	90-100	55-75
3/8-inch	55-75	-
1/4-inch	40-60	35-50
No. 10	(a)	(a)
(a) Of the fraction passing the 1/4-inch sieve, 40% to 60% shall pass the No.10 sieve.		

- D. Comply with "Base Aggregate" as defined by Section 02630 of the OSSC specifications.
- E. Abrasion: When tested in accordance with AASHTO T96: Not to exceed 35 percent after 500 revolutions.
- F. Sand Equivalent: when tested according to AASHTO T176: Not less than 30.

## PART 3 - EXECUTION

### 3.01 PLACEMENT

- A. Obtain Engineer's acceptance of subgrade before placement of base course.
- B. Do not place aggregate base material on soft, muddy or frozen subgrade.
- C. Moisture condition, spread and compact aggregate base course material to the lines, grades and dimensions indicated on the Drawings and in accordance with applicable sections of OSSC Section 00641.
  - 1. Do not haul material over surfacing in process of construction.
  - 2. Spread and distribute material to provide the required density, depth, grade and dimensions with allowance for subsequent lifts.
  - 3. Produce an even distribution of material without segregation. Should segregation occur, modify or change the spreading procedure to correct segregation problems and to result in uniformity in grading.

### 3.02 COMPACTION REQUIREMENTS

- A. Compact aggregate base course material to obtain an In-Place Density of 95 percent of maximum density unless otherwise indicated.
- B. Commence compaction effort by starting at the outer edges of the layer and continue toward the center.
- C. Apply water as needed to obtain required In-Place Density.
- D. Place and compact each lift to required density before succeeding lift is placed.



- E. Blade or otherwise work surfacing as necessary to maintain grade and cross-section at all times, and to keep surface smooth and thoroughly compacted.

### 3.03 TOLERANCES

- A. Structure subgrade: Plus or minus 0.05-foot of the design elevation.
- B. Pavement subgrade: Plus or minus 0.05-foot of the design elevation.
- C. Aggregate Base surface grade: Plus or minus 0.05-foot of the design elevation.

### 3.04 FIELD QUALITY CONTROL

- A. Contractor's compaction testing responsibilities:
  - 1. Accomplish specified degree of compaction in accordance with this specification.
  - 2. Undertake and control compaction effort by confirmation tests to verify that the compaction work complies with the specified degree of compaction.
  - 3. Pay for compaction testing services and submit compaction test reports to the Engineer.
  - 4. If compaction fails to meet specified requirements bring density up to specified level and retest.
    - 1) Costs for conducting additional tests to confirm and verify that remedial work has brought compaction within specified requirements shall be borne by the Contractor.
    - 2) Conduct compaction tests at twice as frequently specified for the initial confirmation tests.
- B. Frequency of Compaction Testing
  - 1. Structures: Make one compaction test for each 50 cubic yards of aggregate base course material placed, with a minimum of one compaction test per structure.
  - 2. Roadway and Paved Areas: Make one test every 1,500 square feet of pavement.

### **END OF SECTION**

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## **SECTION 02953**

### **PAVEMENT RESTORATION**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. The restoration of asphalt and concrete pavements and surfaces, including roadways, driveways, road shoulders, medians, traffic signal loops, pavement markings, curbs, gutters, sidewalks, and any other surfaces that may be damaged as a result of the work.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section:
  - 1. Section 01140 – Work Sequence and Constraints
  - 2. Section 01330 – Submittals
  - 3. Section 02300 – Earthwork
  - 4. Section 02722 – Aggregate Base Course

##### **1.03 REFERENCES**

- A. References in this Section to the State Standard Specifications means the latest edition of the Standard Specifications published by the Oregon Department of Transportation.

##### **1.04 SUBMITTALS**

- A. Provide submittals in accordance with Section 01330.
- B. Submit information for materials to be used in restoring surfaces including mix designs, aggregates, asphalt, pavement fabrics, liquid priming asphalt, surface sealers, roadway striping products, and all other materials to be used for surface restoration.

##### **1.05 DEFINITIONS**

- A. Surface Restoration: The repair or replacement of surface materials back to pre-construction condition or better or as indicated due to the work or damaged as a result of the work.

#### **PART 2 - PRODUCTS**

##### **2.01 MATERIALS**

- A. Aggregate base and sub-base materials:
  - 1. 3/4 –inch ACP, as defined in Section 02722, unless otherwise indicated.

- B. Hot Mix Asphalt Concrete (HMAC) Pavement:
  - 1. Level 2 ACP, 1/2" dense, conforming to Section 00744 of the 2018 Oregon Standard Specifications for Construction, modified by this Section.
- C. Prime coat:
  - 1. Conforming to Section 00700 of the 2018 Oregon Standard Specifications for Construction.
- D. Tack coat:
  - 1. Conforming to Section 00730 of the 2018 Oregon Standard Specifications for Construction.
- E. Traffic Stripes and Pavement Markers:
  - 1. Conforming to the 2018 Oregon Standard Specifications for Construction.
  - 2. Thermoplastic alkyd-type for extrusion application producing an adherent reflectorized stripe capable of resisting deformation by traffic.
- F. Concrete:
  - 1. Conforming to Section 02015 of the 2018 Oregon Standard Specifications for Construction.

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Reconstruct surfaces to pre-construction condition or better unless otherwise indicated, including curbs, gutters, sidewalks, driveways, road shoulders, medians, pavement, ditches, drainage ways, and related items that have been temporarily removed, damaged, or displaced as part of the work.
- B. Reconstruct pavements in conformance with the 2018 Oregon Standard Specifications for Construction, as modified herein.
- C. Coordinate the trench surface pavement restoration with the requirements in Section 01140 and as indicated on the Drawings.
- D. Perform trench pavement restoration following the approved hydrostatic test results of the section being tested unless otherwise indicated.

### **3.02 SAWCUTTING**

- A. Sawcut existing pavement surfaces prior to surface restoration as indicated on the Drawings.
- B. Sawcut in straight lines parallel or perpendicular to existing roadway centerlines a minimum of 12 inches outside the edge of trench unless otherwise indicated.
- C. Where sections of existing pavement remain that are less than 2 feet wide between the proposed sawcut and an existing edge of asphalt concrete, curb, or gutter, remove the existing remaining pavement and replace it as part of the pavement restoration.
- D. Where pavement is damaged outside of sawcut lines, re-cut lines and remove damaged pavement.

- E. Where voids develop under existing pavement to remain, re-cut lines, remove pavement and fill voids.

### 3.03 ASPHALT CONCRETE PAVEMENT SURFACE RESTORATION

- A. Place asphalt concrete in accordance with the following as modified herein:
  - 1. Prepare the road subgrade as specified in Section 02300.
  - 2. Replace trench pavement to match the removed pavement thickness or 4" minimum, whichever is greater, placed in 2" maximum lifts. Replace trench pavement to the extent indicated on the Drawings.
  - 3. Immediately after the asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly compacted by rolling until it is compacted to at least 90% of max density. Max density of the mixture shall be determined in conformance with AASHTO T -209. The surface of each layer and of each course shall be rolled when the temperature of the mixture is above 185-degrees Fahrenheit.
  - 4. Test asphalt concrete per:
    - a. Section 00744.49 of the 2018 Oregon Standard Specifications for Construction.

### 3.04 RESTORATION OF PRIVATE ROADS, PARKING AREAS, AND OTHER PRIVATE IMPROVED AREAS

- A. Reconstruct finished surfaces of private roads, parking areas, and other improved areas with the same materials and to not less than the pre-construction dimensions, unless otherwise indicated.
- B. Reconstruct improvements damaged as part of the work to pre-construction condition or better.
- C. Asphalt Pavement: Match existing pavement thickness, or at least 4 inches of asphalt concrete, whichever is greater.
- D. Gravel, stone, or aggregate surfaces: Match existing thickness, or at least 6 inches, whichever is greater.

### 3.05 RESTORATION OF CONCRETE SURFACES

- A. Reconstruct concrete surfaces including curbs, gutter, sidewalks, wheelchair ramps, medians, valley gutters and any other concrete surface or structure temporarily removed, damaged, or displaced as part of the work in accordance:
  - 1. Section 00759 of the 2018 Oregon Standard Specifications for Construction.

### 3.06 TRAFFIC STRIPES AND PAVEMENT MARKINGS

- A. Replace traffic stripes and pavement markings in conformance with the following as modified below:
  - 1. 2018 Oregon Standard Specifications for Construction.
  - 1. Coordinate with Owner to determine if Local Standard Specification is available. If one is available, it will take precedence over the State Standard Specifications.

- B. Restore traffic stripes and pavement markings in accordance with the following schedule.
  - 1. Place cat tracking for the remaining striping the day following installation of the surface course.
  - 2. Place traffic striping and markings not more than one day following approval of the cat tracking by the roadway jurisdiction.
  - 3. Place pavement markings not more than 2 weeks following installation of the pavement.
- C. Application:
  - 1. Apply thermoplastic material by extrusion method in a single, uniform layer.
  - 2. Use stencils in new condition without bends or damage when applying pavement markings.
  - 3. Completely coat the pavement surface and fill all surface voids with the marking material.
  - 4. Apply glass beads promptly to the molten thermoplastic material.
  - 5. Rates of application
    - a. Stripes: 0.075-inch thick,  $\pm 0.005$  inch.
    - b. Pavement markings: 0.125-inch thick,  $\pm 0.005$  inch
    - c. Glass beads: 8 pounds per 100 square feet.

### 3.07 PAVEMENT MARKERS

- A. Restore pavement markers in accordance with:
  - 1. 2018 Oregon Standard Specifications for Construction.
  - 2. Contractor to coordinate with Owner to determine if Local Standard Specification is available. If one is available, it will take precedence over the State Standard Specifications.

### 3.08 RAISING MANHOLE, VALVE, AND OTHER UTILITY COVERS

- A. Place temporary steel covers over manhole and valve boxes prior to placing permanent pavement.
- B. Following pavement installation, remove the temporary covers and install grade rings as necessary to adjust the surface of the frames and covers to conform to the surface of the surrounding pavement surface.
- C. Following adjustment of the frames and covers, neatly chip with a flat tool or sawcut the pavement around each frame to provide a smooth, even, vertical surface.
- D. Install asphalt concrete in accordance with this Section, to provide a smooth surface around each frame, so that the frame, cover and pavement surfaces match.

### **END OF SECTION**

**SECTION 03301**  
**CAST-IN-PLACE CONCRETE**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Requirements for cast-in-place concrete work.

1.02 REFERENCED SECTIONS

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals

1.03 SUBMITTALS

- A. Comply with Section 01330.
- B. Shop Drawings
  - 1. Reinforcing Steel: Prepare shop fabrication and field installation drawings in accordance with CRSI Manual of Standard Practice and ACI SP.
  - 2. Layout drawings for construction joints.
- C. Product Data: Waterstops, curing, form release agent compound data.
- D. Concrete Mix Design: Data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.
- E. Quality Control Submittals
  - 1. Manufacturer's application instructions for curing compound.
  - 2. Ready-mix delivery tickets for each truck in accordance with ASTM C94.

1.04 QUALITY ASSURANCE

- A. Supplier Qualifications: A minimum of 5 years' experience manufacturing ready-mixed concrete and that complies with ASTM C94 for production facilities and equipment.
- B. Source Limitations: Use the same brand of cement from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- C. Concrete and Reinforcement: Unless otherwise specified, meet the requirements of ACI 301 and 318.
- D. Hot Weather Concreting: Conform to ACI 305R.

**PART 2 - PRODUCTS**

2.01 FORMWORK

- A. Exposed Areas: Use hard plastic or finished plywood.
- B. Unexposed Areas: Use new ship lap or plywood.

- C. Earth cuts may be used for forming footings.

## 2.02 CONCRETE

- A. Ready-mixed meeting ASTM C94, Option A.
- B. Portland Cement: ASTM C150, Type II.
- C. Aggregates: Furnish from one source.
  - 1. Natural Aggregates
    - a. Free from deleterious coatings and substances in accordance with ASTM C33, except as modified herein.
    - b. Free of materials and aggregate types causing pop outs, discoloration, staining, or other defects on surface of concrete.
  - 2. Non-Potentially Reactive: In accordance with ASTM C33, Appendix XI, paragraph X1.1.
  - 3. Aggregate Soundness: Test for fine and coarse aggregates in accordance with ASTM C33 and ASTM C88 using sodium sulfate solution.
  - 4. Fine Aggregates
    - a. Clean, sharp, natural sand.
    - b. ASTM C33.
    - c. Materials Passing 200 Sieve: 4 percent maximum.
    - d. Limit deleterious substances in accordance with ASTM C33, Table 1 with material finer than 200 sieve limited to 3 percent, coal and lignite limited to 0.5 percent.
  - 5. Coarse Aggregate
    - a. Natural gravels, combination of gravels and crushed gravels, crushed stone, or combination of these materials containing no more than 15 percent flat or elongated particles (long dimension more than five times the short dimension).
    - b. Materials Passing 200 Sieve: 0.5 percent maximum.
- D. Admixtures: Do not use admixtures that contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Air-Entraining: ASTM C260.
  - 2. Water-Reducing: ASTM C494, Type A or D.
  - 3. Superplasticizers: ASTM C494, Type F or G.
  - 4. Fly Ash: ASTM C618, Class C or F.
  - 5. Slag Cement: ASTM C989
  - 6. Color Pigments: Inert mineral or metal oxide pigments, natural or synthetic; resistant to lime and other alkalis.
- E. Concrete Mix Design
  - 1. Minimum Compressive Field Strength: 4,000 psi at 28 days when cured and tested in accordance with ASTM C31 and C39.



2. Coarse Aggregate Size: 1 inch and smaller.
3. Slump Range: 3 to 5 inches.
4. Air Entrainment: Between 3 and 6 percent by volume.
5. Water Reducers: Use in concrete without plasticizers.

F. Proportions

1. Design mix to meet aesthetic and structural concrete requirements.
2. Water-cement ratio (water-cement plus fly ash plus slag ratio) shall control amount of total water added to concrete as follows:

Coarse Aggregate Size	W/C Ratio
1-1/2 inch	0.45
1 inch	0.40

3. Minimum Cement Content (Combined Cement Plus Fly Ash plus Slag Cement Content):
  - a. 517 pounds per cubic yard for concrete with 1-1/2 inch maximum size aggregate.
  - b. 540 pounds per cubic yard for 1 inch maximum size aggregate.
4. Increase cement content (combined cement plus fly ash plus slag content), as required meeting strength requirements and water-cement ratio.
5. Fly Ash and/or Slag Cement Content: minimum 20 percent, maximum 50 percent by weight of total cement content.

- G. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Non-agitating equipment is not allowed.

## 2.03 FIBERGLASS REINFORCED GROUT

- A. Fiber Reinforced Concrete: ASTM C1116, Type III.
- B. Ready-mixed meeting ASTM C94, Option A.
- C. Portland Cement: ASTM C150, Type II.
- D. Hydrated Lime: ASTM C207, Type S.
- E. Aggregates: Furnish from one source.
  1. Natural Aggregates
    - a. Free from deleterious coatings and substances in accordance with ASTM C33, except as modified herein.
    - b. Free of materials and aggregate types causing pop outs, discoloration, staining, or other defects on surface of concrete.
  2. Non-Potentially Reactive: In accordance with ASTM C33, Appendix XI, paragraph X1.1.
  3. Aggregate Soundness: Test for fine and coarse aggregates in accordance with ASTM C33 and ASTM C88 using sodium sulfate solution.

4. Fine Aggregates
  - a. Clean, sharp, natural sand.
  - b. ASTM C33.
  - c. Materials Passing 200 Sieve: 4 percent maximum.
  - d. Limit deleterious substances in accordance with ASTM C33, Table 1 with material finer than 200 sieve limited to 3 percent, coal and lignite limited to 0.5 percent.
- F. Fibers: 0.3 mm or larger, Synthetic, ASTM D7508, dosage rate determined by ready mix supplier.
- G. Admixtures: Do not use admixtures that contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Water-Reducing: ASTM C494, Type A or D.
  2. Superplasticizers: ASTM C494, Type F or G.
  3. Fly Ash: ASTM C618, Class C or F.
  4. Slag Cement: ASTM C989
- H. Grout Mix Design
  1. Minimum Compressive Field Strength: 3,000 psi at 28 days in accordance with ASTM C1019.
  2. Aggregate: ASTM C404.
  3. Slump Range: 5-11 inches.

## 2.04 REINFORCING STEEL

- A. Deformed Bars: ASTM A615, Grade 60.
- B. Welded Wire Reinforcement: ASTM A185, fabricated from as-drawn steel wire into flat sheets.
- C. Bar Supports:
  1. For Slab Rebar: Concrete blocks or plastic bar supports.
  2. For Rebar in Walls, Beams, Columns, and Slabs Exposed to View: Galvanized steel chairs with plastic tips or plastic bar supports and side form spacers.

## 2.05 ANCILLARY MATERIALS

- A. Curing Compound
  1. Material: Solvent based containing chlorinated rubber solids in accordance with ASTM C309, with additional requirement that the moisture loss not exceed 0.030 gram per centimeter squared per 72 hours.
  2. Manufacturers and Products
    - a. Master Builders Co.; Masterkure CR
    - b. Euclid Chemical Co.; Euco Super Floor Coat

- c. Atlas Quantum-Cure 61 (NSF/ANSI Standard 61-certified product, May 2016)
  - d. Dayton Superior (NSF/ANSI Standard 61-certified product, May 2016)
- B. Epoxy Bonding Agent and Adhesives (for Binding New Concrete to Existing Concrete)
  - 1. Epoxies: Two component material for use on dry or damp surfaces and conforming to the requirements of ASTM C881.
  - 2. Apply in accordance with manufacturer's recommendations.
  - 3. Epoxy Bonding Agent for water-containing structures at potable water treatment or storage tanks shall have NSF/ANSI Standard 61 certification for contact with water for the water-containing structure's area/volume ratio.
  - 4. Manufacturers: One of the following or equal:
    - a. Sika Armatec 110 EPOCEM; Sika Chemical Corporation.
    - b. CCS Bonder Paste LWL; Chemco Systems.
- C. Waterstops
  - 1. General: Place hydrophilic and/or rubber dumbbell type or center bulb type waterstops at construction joints and other joints as specified and indicated on the Drawings.
  - 2. Hydrophilic Waterstops:
    - a. Use: For concrete repairs or when attaching new concrete to existing structures.
    - b. Manufacturers: One of the following or equal:
      - 1) Greenstreak, Hydrotite CJ.
      - 2) Tremco, Parastop II.
    - c. Installation: As indicated on the Drawings and in accordance with manufacturer's instructions.
  - 3. Rubber Waterstops
    - a. Use: At new construction joints where indicated on the Drawings.
    - b. Material: PVC or rubber waterstops manufactured by one of the following, or equal:
      - 1) Greenstreak.
      - 2) Progress Unlimited.
      - 3) Williams Products.
    - c. Size:
      - 1) Construction and Contraction Joints. 6-inch flat dumbbell type.
      - 2) Expansion Joints: 9-inch wide dumbbell with hollow center bulb.
- D. Vapor Barrier
  - 1. Material: 15 mil, multilayer plastic, 0.01 minimum permeance rating.
  - 2. Manufacturers: One of the following or equal:
    - a. StegoWrap, Stego Industries.

- b. Premoulded Membrane Vapor Seal with Plasmatic Corel, W. R. Meadows.
- E. Form-Release Agent
  - 1. Water-based, high solids content non-yellowing curing compound meeting requirements of ASTM C309 and C1315.
  - 2. Moisture Loss: 0.40 kg/square m/72 hours maximum.
  - 3. Capable of meeting moisture retention at manufacturer's specified application rate.
  - 4. Manufacturers and Products:
    - a. Atlas; Bio-Guard.
    - b. Dayton Superior; Clear Strip JIEF.

### **PART 3 - EXECUTION**

#### **3.01 FORMWORK**

- A. Design, construct, erect, brace and maintain formwork in accordance with ACI 301.
- B. Form Ties
  - 1. Fixed conical or spherical type inserts that remain in contact with forming material and allow for dry packing of form tie holes.
  - 2. Space ties to withstand pressures and to limit deflection of forms to acceptable limits.
  - 3. Wire ties are not acceptable.
- C. Construction
  - 1. In accordance with ACI 347.
  - 2. Make joints tight to prevent escape of mortar and to avoid formation of fins.
  - 3. Brace as required to prevent distortion during concrete placement.
  - 4. On exposed surfaces locate form ties in uniform pattern or as shown.
  - 5. Construct so ties remain embedded in the wall with no metal within 1-inch of concrete surface when forms, inserts, and tie ends are removed.
- D. Form Removal
  - 1. Remove after concrete has attained 28 day strength, or approval is obtained in writing from Engineer.
  - 2. Remove forms with care to prevent scarring and damaging the surface.

#### **3.02 PLACING REINFORCING STEEL**

- A. Place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.
- B. Field bending or welding of reinforcing bars will not be allowed.
- C. Bar Supports: Provide in sufficient quantity to prevent sagging and to support bars during concrete placement.

D. Splices and Laps

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.
2. Horizontal wall bars are considered top bars.
3. Bar lap splices shall conform to General Structural Notes on the Drawings.
4. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Before placing concrete:

1. Check reinforcing steel for proper placement and correct discrepancies.
2. Remove excessive rust, mill scale, dirt, oil and other material from rebar that may adversely affect bonding to concrete.
3. Remove water from excavation and debris and foreign material from forms.

C. Before depositing new concrete on existing concrete, clean surface using sandblast or other mechanical means to obtain a 1/4 inch rough profile, and apply epoxy bonding agent in accordance with the manufacturer's instructions.

D. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. Place within 1-1/2 hours after adding cement to mix.

E. Placement Limitations: 8 feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.

F. Hot Weather

1. Prepare ingredients, mix, place, cure, and protect in accordance with ACI 305R.
2. Maintain concrete temperature below 80 degrees F at time of placement, or furnish test data or provide other proof that admixtures and mix ingredients do not produce flash set plastic shrinkage, or cracking due to heat of hydration. Ingredients may be cooled before mixing to maintain fresh concrete temperatures at 80 degrees F or less.
3. Make provisions for windbreaks, shading, fog spraying, sprinkling, ice, or wet cover, or other means to provide concrete with temperature specified.
4. Maximum allowable temperature differential between reinforcing steel and concrete: Not greater than 20 degrees F at the time of concrete placement.

3.04 COMPACTION

A. Vibrate concrete as follows:

1. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.
2. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.
3. Vibrate until concrete becomes uniformly plastic.

4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

### 3.05 CONSTRUCTION JOINTS

- A. Locate as shown or as approved.
- B. Maximum Spacing Between Construction Joints: 40 feet, unless otherwise indicated.

### 3.06 CRACK CONTROL JOINTS

- A. Provide crack control joints in concrete slabs on grade, curbs, gutters, sidewalks and other concrete flatwork as follows:
  1. Install crack control joints by use of grooving tool on fresh concrete or saw-cut by use of a saw designed for crack control joints as soon as the concrete hardens sufficiently to support the saw, however, no longer than 12 hours after concrete placement.
  2. Depth: 1/4 the thickness of the slab.
  3. Frequency: Unless otherwise indicated,
    - a. At least 2 times the slab thickness in feet (6-inch slab = 12 foot on center).
    - b. Rectangular slabs: Maximum spacing 1-1/2 to 1

### 3.07 FINISHING FLOORS AND SLABS

- A. Unexposed Slabs: Screed to true surface, bull float with wood float, and wood trowel to seal surface and to provide a uniform surface.
- B. Exposed Slabs to Receive Grout: Screed to indicated elevation and leave without special finish.
- C. Exposed Floors and Slabs: Screed to true surface and use bull float to form a uniform surface with minor texture then apply final surface finish.
- D. Final Surface Finishes for Exposed Floors and Slabs: Apply final surface finish as scheduled.
  1. Walkway finish: Apply to concrete surfaces that will be used for foot traffic such as walkways around basins and sidewalks. Apply steel trowel surface, then a light hairbroom finish to produce a profile that is parallel to the slab drainage.
  2. Scratch Finish: Apply to surfaces receiving concrete floor topping and other bonded cementitious floor finishes, unless otherwise indicated on the Drawings. Use brushes or brooms with stiff bristles to produce 1/4-inch deep scratches.
  3. Float Finish: Apply to slabs of water-bearing basins and channels and to roof surfaces to receive membrane roofing. Use power-driven floats or hand floats to produce a surface that is uniform and smooth.
  4. Trowel Finish: After applying float finish, trowel surface until surface is uniform in texture and appearance and free of trowel marks. Apply trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet or tile.

5. Non-slip Finish: After concrete has been screeded level and slightly hardened, sprinkle abrasive onto surface, wood float into concrete, and trowel abrasive into surface to obtain the proper non-slip finish with the exposed abrasive.
- E. Tolerances: Exposed surfaces shall not vary from level or true plane more than 1/4 inch in 10 feet when measured with a straightedge.

### 3.08 FINISHING AND PATCHING FORMED SURFACES

- A. Unexposed Surfaces: Provide rough-formed concrete texture as imparted by form-facing material, fill form tie holes with nonshrink grout and grind off projections, fins, and rough spots.
- B. Exposed Surfaces: Provide smooth-formed concrete texture as imparted by form-facing material, arranged in an orderly and systematic manner with a minimum number of seams. Fill form tie holes with nonshrink grout and grind off projections, fins, and rough spots. Where scheduled, apply rubbed surface as follows:
  1. Smooth Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive to produce a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
  2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes.
    - a. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces.
    - b. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
  3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout.
    - a. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces.
    - b. Compress grout into voids by grinding the concrete surface in a swirling motion, then finish the surface with a cork float.:
- C. Patching Defective Areas: Patch defective areas and repair rough spots resulting from form release agent failure or other reasons to provide smooth uniform appearance.
  1. Contact Engineer prior to patching defective areas.
  2. Cut out honeycombed and defective areas.
  3. Cut edges perpendicular to surface at least 1-inch deep. Do not feather edges. Soak area with water for 24 hours.
  4. Finish surfaces to match adjacent concrete.
  5. Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.

### 3.09 PROTECTION AND CURING

- A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.
- B. Keep concrete slabs continuously wet for a 7 day period. Intermittent wetting is not acceptable.
- C. Use curing compound only where approved by Engineer. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is complete.
  - 1. Do not use curing compound on concrete surfaces that will be painted.
- D. Remove and replace concrete damaged by freezing.

### 3.10 FIELD QUALITY CONTROL

- A. Concrete Samples:
  - 1. Provide concrete for making composite samples for testing slump, air content, and for making cylinders for determination of compressive strength.
  - 2. Prepare samples in accordance with ASTM C172. Select trucks or batches of concrete on a random basis.
  - 3. Samples may be obtained at the discharge chute of the truck or at the point of discharge into forms.
- B. Sampling Frequency: One composite sample for each 100 cubic yards of structural concrete, or fraction thereof, of each concrete mixture placed in any one day.
- C. Evaluation will be in accordance with ACI 301, Chapter 17 and Specifications.
- D. Slump tests and concrete cylinders will be made by the Owner. Owner will handle cured test cylinders, transport to the testing laboratory and pay testing costs.
- E. Enforcement of Compressive Strength Requirements:
  - 1. Compressive strength of concrete will be considered acceptable if the following conditions are satisfied:
    - a. Averages of all sets of 3 consecutive strength test results are greater or equal to the specified compressive strength.
    - b. No individual strength test (average of 2 cylinders) falls below specified compressive strength by more than 500 pounds per square inch.
  - 2. Whenever one, or both, of 2 conditions stated above is not satisfied, provide additional curing of affected portion of structure, then obtain test cores from the affected area.
    - a. Obtain 3 test cores in accordance with ASTM C42 and ACI 318.
    - b. Concrete will be considered acceptable if the average compressive strength of the 3 test cores is equal to at least 90 percent of the specified 28-day compressive strength and no single core is less than 80 percent of the specified 28-day compressive strength.
    - c. Concrete will be designated as defective when the specified conditions are not achieved.
    - d. Fill core holes with concrete.



3. Engineer may require the Contractor to strengthen defective concrete by means of additional concrete, additional reinforcing steel, or replacement of defective concrete, all of the Contractor's expense.

**END OF SECTION**

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**SECTION 03315**  
**CONCRETE REPAIR**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Repair of concrete cracks and joints, including, but not limited to, the following:
  - 1. Sealing of cracks and crack networks that are wider than a minimum thickness of 2 mils (0.002 inch) or cracks as directed by the Owner by pressure-injected epoxy resin.
  - 2. Expansion joint repair as shown on the drawings.
  - 3. Concrete Wall Repair
  - 4. Launder trough repair.
  - 5.

**1.02 QUALITY ASSURANCE**

- A. Manufacturer's Field Services
  - 1. The material manufacturer shall provide engineering field services to review the project and the material application prior to any preparation; to approve the applicator, the material used, and the procedure to be used; to observe surface preparation; to approve surface preparation; and to observe application.
  - 2. The field representative shall be an employee of the material manufacturer.
- B. Applicator
  - 1. The applicator shall hold a valid State of Oregon Contractor's license for performing concrete repair work. The Contractor and the personnel doing the applications shall have a minimum of five (5) years practical experience and successful history in epoxy injection process for concrete crack repair. The Contractor shall substantiate this requirement by furnishing a written list of references and resumes with the bid package that includes a list of projects with previous crack repair projects.

**1.03 SUBMITTALS**

- A. Provide the following information for both the pressure grouting of cracks and for the repair of the expansion joints:
  - 1. The applicator shall submit through Contractor a satisfactory experience record including references from previous application of the specified materials to structures of similar design and complexity.
  - 2. Resume of the personnel responsible for the work in the field.
  - 3. Manufacturer's technical data on product and recommended use. Include the brand name and series number of all materials to be used.

4. The field representative of the material manufacturer shall submit, in writing through Contractor, approvals of proposed material, application procedures, applicator, and surface preparation.
5. Manufacturer's application instructions, equipment recommendation, temperature and humidity limitations, pot life and induction requirements, drying and curing times, and recoat cycle times. Recoat times and final cure shall be listed at 45° F., 55° F., 65° F. and 75° F. substrate temperatures. Provide manufacturer's maximum and minimum material and substrate temperatures for proper application.
6. Equipment information for pressure injection of epoxy.

#### 1.04 INSPECTION

- A. All materials furnished, and all work accomplished under the contract shall be subject to inspection by the Owner.
- B. The Owner's Representative may perform inspection on all phases of the surface preparation, abrasive blast cleaning, and application of the concrete repair materials.
- C. Quality assurance procedures and practices shall be utilized to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and acceptable professional standards and are approved by the Owner.
- D. The Contractor shall be held strictly to the true intent of the Specifications regarding quality of materials, workmanship, and diligent execution of the contract. Owner or Owner's Representative inspection of the work in no way reduces or alters the quality control and quality assurance responsibilities of the Contractor or reduces or alters the Contractor's compliance with all requirements of the contract.

#### 1.05 SAFETY AND HEALTH REQUIREMENTS

- A. The Contractor shall comply with the applicable health and safety requirements of the State of Oregon and OSHA. The Contractor shall provide and require the use of proper personal protective and lifesaving equipment for all persons visiting or working in or about the project site.
  1. The secondary clarifiers are considered non-permit confined spaces. Contractor is to coordinate with the Owner to understand all responsibilities and procedures.
- B. Ventilation shall be used to control potential exposure and hazard to workers and employees of the plant. Ventilation equipment shall of industrial design, and of adequate capacity to reduce the concentration of air contaminants to the degree that a hazard to workers or employees of the plant does not exist. The ventilation system shall be sufficient to maintain air changes within the confined space in accordance with OSHA regulations. Ventilation equipment shall operate by ducting air, vapors, and other potential hazardous substances from the confined space. Forced air ventilation during blast cleaning, abrasive removal, coating application, and curing is mandatory in confined spaces.
- C. When cutting, drilling or sandblasting use methods that prevent the creation and dispersion of free crystalline silica.
- D. A ventilation system shall be furnished and installed by the Contractor in accordance with these specifications. The Contractor shall make modifications to the system as directed by the supplier of the equipment, to insure a safe working environment and provide complete removal of all solvent vapors.

- E. Spark proof artificial lighting shall be provided for all work in confined spaces. Light bulbs shall be guarded with a protective cage to prevent breakage. Lighting fixtures and bulbs shall comply with the requirements of Section 70 of the National Fire Protection Association (NFPA), "National Electric Code", for the atmosphere in which they are used. All lighting and other electrical systems used on the project shall be of the ground fault type, as detailed in NFPA 70. Whenever required by the Owner, the Contractor shall provide additional illumination to fully illuminate all areas to be inspected. The level of illumination required for inspection purposes shall be solely determined by the Owner and as called out in this specification.
- F. All ladders, scaffolding and rigging shall be designed for their intended use and shall conform to all requirements of OSHA regulations. They shall be erected where requested by the Owner to facilitate inspection and moved by the Contractor to the locations requested by the Owner. All scaffolding shall have proper "outriggers", cross bracing, handrails, ladders, and OSHA approved and tested planking.
- G. The Contractor shall accord particular attention to the manufacturer's recommendations, precautions, and warnings regarding the handling and use of cleaning, coating materials specified herein. Coating materials may be irritating to the skin and eyes and may cause an allergic reaction in certain persons. When handling and mixing coatings and paints, workers shall wear proper protective clothing and equipment, including gloves, respirators and eye protection. Flammability, toxicity, allergenic properties, and any other characteristic requiring field precautions shall be identified, and specific safety practices shall be followed.

## **PART 2 - PRODUCTS**

### **2.01 PERFORMANCE AND DESIGN REQUIREMENTS**

- A. Unless otherwise specified or authorized, repairs shall conform to the requirements specified herein.
- B. Types of repairs not specified herein shall be as specified in other sections, as indicated on the Drawings, or, in the absence of any definite requirement, as recommended by the manufacturer's representative and subject to acceptance by the Construction Manager.
- C. The following types of repairs shall be performed as required.
  - 1. Sealing of cracks and crack networks that are wider than a minimum thickness of 2 mils (0.002 inch) or as directed by the Owner by pressure injected epoxy resin.
  - 2. Expansion joint repair as shown on the drawings.
  - 3. Concrete Wall Repair
  - 4. Launder trough repair.

### **2.02 ACCEPTABLE PRODUCTS**

- A. Repair products/materials shall be manufactured by the companies specified herein.
- B. Equivalent products of other manufacturers regularly producing high quality concrete repair products/materials and providing engineering field services may be furnished subject to review and acceptance by the Owner.

## 2.03 MATERIALS

- A. Materials shall be as specified or as recommended by the manufacturer including compatibility with temperature and moisture conditions encountered.
- B. Grout:
  - 1. Sikacrete 211 SCC Plus
  - 2. MasterEmaco S 466CI
  - 3. Or Approved Equal
- C. Corrosion Inhibitor:
  - 1. Sika Armatec 110 Epocem
  - 2. MasterEmaco P 124
  - 3. Or Approved Equal
- D. Bonding Agent:
  - 1. Sika Armatec 110 Epocem
  - 2. MasterEmaco P 124
  - 3. Or Approved Equal
- E. Expansion Joints:
  - 1. Polyurethane, high elasticity adhesive
  - 2. Sikaflex – 3c NS or Master-Seal
- F. Weir Plate Joint Filler:
  - 1. Sikaflex – 2C EZ Mix with 429 Primer
  - 2. Or Approved Equal
- G. Pressure-Injected Epoxy Resin
  - 1. ASTM C881, Type IV, moisture sensitive , maximum viscosity 350 cps at 77°F. KonTek 111 LV IR, Sika “Sikadur 52”, Master Builders “MasterInject 1380”
- H. Pressure Grouting Equipment
  - 1. Shall include a mixer and holdover agitator tanks and be designed to place grout at pressure.
  - 2. Gages shall be provided to indicate pressure used.
- I. Concrete Wall and Trough Repair
  - 1. BASF MasterEmaco S 211SP; Tnemec Series 217 Mortarcrete; Sika Armatec 110 primer and Sikarepair 224. For the selected material, Contractor shall prepare three test plots and apply the material per manufacturer’s recommendations and conduct the pull-off test per ASTM C1583 to demonstrate performance.

## **PART 3 - EXECUTION**

### **3.01 INSPECTION**

- A. Prior to the placement of the repair materials, the surfaces or cracks to be repaired shall be inspected by the material manufacturer to assure that preparation and conditions are correct for the type of repair and the product/material being used as specified herein. Written approval by the manufacturer shall be provided per Section 1.4.

### **3.02 PREPARATION**

- A. All cracks and surfaces around the cracks shall be free of objectionable substances and shall conform to the requirements of the material manufacturer.
- B. Concrete and shotcrete to be repaired shall be cleaned by methods acceptable to the material manufacturer so that the cracks are free of dirt, oil, grease, laitance, and other foreign matter.
- C. All loose and deteriorated existing concrete and shotcrete surfaces shall be removed down to sound materials
- D. All concrete and shotcrete shall be checked for delamination to ensure that all surfaces are sound. All edges shall be square cut to avoid feather edges.
- E. Any other preparation recommended by the material manufacturer shall be brought to the Owner's attention and may be incorporated into the Work if acceptable to the Owner, but at no additional cost to the Owner.
- F. Concrete and shotcrete surfaces in the area of a crack to be repaired shall be cleaned by wire brushing, blasting, or other acceptable methods.
- G. Concrete wall surfaces shall be cleaned to expose crack networks.
- H. Concrete wall surfaces and troughs shall be prepared using high pressure washing followed by sand blasting to provide a CSP-6 surface.
- I. If there is active water seepage in the repair area, the seepage shall be stopped as recommended by the injection material manufacturer and as acceptable to Owner.
- J. Injection ports shall be installed when recommended by the injection material manufacturer.
- K. Injected Epoxy Resin
  - 1. Preparation for injected epoxy resin shall include sealing the surface at the crack with crack sealant as recommended by the material manufacturer and as acceptable to the Owner for the pressure injection work.
  - 2. Injection ports for epoxy resin shall penetrate through the crack sealant into the cracks at spacing recommended by the material manufacturer.

### **3.03 APPLICATION**

- A. Concrete and shotcrete repair work shall be performed in accordance with the following requirements.
  - 1. Pressure-Injected Resin
    - a. The injected areas shall be prepared as specified and as recommended by the manufacturer.

- b. Pressure-injected resin shall be suitable for penetration of joints, cracks, and crack networks 2 mils (0.002 inch) wide and larger.
  - c. After the joints and cracks are prepared and before the injection of the resin, the joints shall be flushed with water.
  - d. Terminate the water flush when the turbidity of the expelled water is equal to that of the flush water.
  - e. The pumping equipment used for the pressure injection of resin shall have pressure metering.
    - 1) Written procedures for use and quality control of the injection equipment shall be furnished to the Construction Manager for review and acceptance.
    - 2) The pump shall be electric.
    - 3) The material and process used for the pressure injection of the resin shall have been in use a minimum of five (5) years.
  - f. The joints and crack networks shall have a minimum of 90 percent (90%) penetration of resin into the joint or crack network.
  - g. Epoxy penetration shall be indicated by appearance at the adjacent entry port.
  - h. Core samples may be taken at the Construction Manager's discretion.
    - 1) Epoxy Resin
      - a) Epoxy resin shall be injected into the structure in accordance with the material manufacturer's recommendations and as acceptable to Construction Manager.
      - b) Epoxy resin shall be injected until the resin appears at the next port.
2. Cold Weather
- a. Do not work when ambient temperatures are expected below 40°F
  - b. Sudden cooling of the repair materials shall not be permitted.
3. Walls
- a. Apply concrete repair product with a minimum thickness of 1/4 inch. A uniform and smooth finished surface shall be provided.

### 3.04 TESTING

- A. Walls and all other surfaces shall be tested by the Contractor in compliance with ASTM C1583. A minimum pull-off strength of 150 psi at the concrete substrate shall be provided. Lower pull-off strength will be accepted provided that the failure is in the substrate concrete and not at the bond, in the applied material or on the adhesion of the test dolly.
  - 1. Test at locations selected by the Owner.
  - 2. Up to 20 tests shall be provided. Additional tests will be required at the Contractor's expense if needed to demonstrate compliance.
  - 3. The Owner may elect to conduct additional testing.



- B. Grout used for repair of troughs and other structural repairs.
  - 1. Provide four cylinders each day when repairs are being made for Owner testing.
  - 2. Required 28-day compressive strength of 5,000 psi.

### 3.05 PROTECTION

- A. Post-placement curing and protection shall be as specified herein and in accordance with the manufacturer's recommendations.

### 3.06 CLEANING AND FINISH

- A. Clean work areas each day in accordance with the project requirements section.
- B. Upon completion of crack repairs, sack exterior exposed walls.
  - 1. Repair defective work, remove fins, correct offsets, and grind projections smooth.
  - 2. Fill depressions 1/16 inch or larger in depth or width and tie holes with mortar.
  - 3. "Brush-Off" sandblast surfaces prior to filling holes to expose all holes near surface of the concrete.
  - 4. Thoroughly wet surfaces and commence filling of pits, holes, and depressions while surfaces are still damp.
  - 5. Perform filling by rubbing mortar over entire area with clean burlap, sponge rubber floats, or trowels.
  - 6. Do not let any material remain on surfaces, except that within pits and depressions.
  - 7. Wipe surfaces clean and moist cure.
- C. Upon completion of the final cleanup, restore areas affected by the grouting procedures to their original condition, leaving no trace of material piles or other wasted materials.

### **END OF SECTION**

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## **SECTION 03600**

### **GROUT**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Grout for uses other than masonry construction, including:
  - 1. Dry pack grout
  - 2. Cement grout
  - 3. Nonshrink grout, non-metallic
  - 4. Nonshrink grout, metallic
  - 5. Pressure grout
  - 6. Epoxy grout
  - 7. Polymer concrete

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 03301 – Cast-in-Place Concrete
  - 3. Section 11002 – Equipment Mounting

##### **1.03 SUBMITTALS**

- A. Conform to Section 01330.
- B. Product Data
  - 1. Manufacturer's product data of all materials proposed for use in the Work.
  - 2. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement and appropriate uses for each type of grout used in the Work
- C. Laboratory Test Reports
  - 1. Test reports on previously tested materials shall be accompanied by the manufacturer's statement that the previously tested material is the same type, quality, manufacture, and make as that proposed for use in this project.
  - 2. Test reports are required for the following:
    - a. Cement
    - b. Aggregates
    - c. Bonding compounds
    - d. Admixtures

- D. Certifications that all grout used on the project are free of chlorides or other chemicals that may cause corrosion.

#### 1.04 QUALITY ASSURANCE

##### A. Field tests

1. Compression test specimens will be taken during construction from the first placement of each type of grout and at intervals thereafter as selected by the Owner to ensure compliance with the Contract Documents.
2. The test specimens will be obtained, tested, and paid for by the Owner except the Contractor will be charged the cost of any additional tests on work which does not meet the Specifications.
3. Compression tests for grout and non-shrink grout:
  - a. Per ASTM C109.
  - b. Obtain three samples.
  - c. At a minimum test at 7 and 28 days.
4. Compression test for epoxy grout:
  - a. Per ASTM C579 Method B.
  - b. Obtain three samples.
  - c. At a minimum test at 7 days.
5. Remove and replace all grout that does not meet the Specification requirements at no additional cost to the Owner.

##### B. Pre-installation demonstration and training.

1. Coordinate and pay for demonstration and training sessions by the grout manufacture where pre-installation demonstration and training is indicated in the grout schedule before grout installation is started.
2. Conduct training with the Contractor's employees who will be doing the grout work in attendance.
3. Include demonstration and training on mixing, preparation, application and curing each type of grout to be used.
4. Obtain test specimens of each grout type and conduct compression testing at 1, 3, and 28 days for each type of grout to be used. Demonstration and training testing to be paid for by the Contractor.
5. Demonstration and training sessions may be conducted on actual project placements such as baseplates and tie holes.
6. Mix sufficient amount of each grout type to complete the equivalent of one 12-inc by 12-inch baseplate and a set of 6 test specimens.
7. Transport test cubes to an independent test laboratory, obtain test reports, and submit test results to the Owner.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Use grouts indicated in the grout schedule whether called for on Drawings or not.

### 2.02 CEMENT GROUT

- A. Portland cement ASTM C150 Type II or Type V
- B. Low alkali, containing less than 0.60 percent alkalies.
- C. Aggregate
1. Nonreactive and washed before use.
  2. Fine Aggregate
    - a. Hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine and shall conform to ASTM C33 as modified herein.
    - b. Gradation (ASTM C136): 100 percent by weight will pass a standard No. 8 mesh sieve and no less than 45 percent by weight will pass a standard No. 40 mesh sieve.
    - c. Tolerance: The average of three consecutive tests fall within the limits listed below:

US standard sieve size	Permissible variation in individual tests, percent
30 or coarser	2.0
50 or finer	0.5

3. Meet the requirements of the following specifications:

Test	Test Method	Requirements
Organic Impurities	ASTM C40	Color lighter than standard
Amount of Material Passing No. 200 Sieve	ASTM C117	3% maximum by weight
Soundness	ASTM C88	10% maximum loss with sodium sulfate
Reactivity	ASTM C289	Innocuous aggregate
Sand Equivalent	ASTM D2419	Minimum 80

4. Admixtures

- a. General
- 1) Compatible with the grout.
  - 2) Do not use calcium chloride or admixtures containing calcium chloride.
  - 3) Follow the manufacturer's recommendations for use.
  - 4) Add separately to the grout mix.

- b. Water Reducing Retarder
  - 1) ASTM C494 Type D.
  - 2) Manufactured by:
    - a) Master Builders MasterSet R 300,
    - b) Sika Corporation Plastiment,
    - c) Or equal.
- c. Lubricant for Cement Pressure Grouting
  - 1) Manufactured by:
    - a) Intrusion Prepakt Intrusion Aid,
    - b) Sika Intraplast N,
    - c) Or equal.

5. Water

- a. Free from oil and deleterious amounts of acids, alkalies, and organic materials;
- b. Do not use water containing more than 500 mg/l of chlorides as Cl, nor more than 800 mg/l of sulfates as SO<sub>4</sub>;
- c. Do not use water containing impurities that may cause a change of more than 25 percent in the setting time of the cement nor a reduction of more than five percent in the compressive strength of the grout at 14 days when compared with the result obtained with distilled water.
- d. Do not use water for curing that discolors the grout.

D. Drypack Grout

- 1. A mixture of approximately one part cement, 1-1/2 to 2 parts sand, water reducing retarder, and sufficient water to make a stiff workable mix.
- 2. Consistency: Plastic and moldable but does not flow.

E. Cement Grout

- 1. Mixture of one part cement, two parts sand, proportioned by volume, admixtures for pressure grouting, and sufficient water to form workable mix.
- 2. Maximum slump: 4 inches.

## 2.03 PREPACKAGED GROUT

A. Non-shrink Grout

- 1. Cementitious non-shrink, non-metallic grout
- 2. Conform to ASTM C827 and C1107.
- 3. Manufactured by:
  - a. Sika Corporation, SikaGrout 212
  - b. Five Star Products, Inc. Five Star Grout
  - c. Chemrex Inc. Masterflow 928
  - d. Euclid Chemical Co. High-Flow Grout
  - e. Or equal.

- B. Epoxy grout bonding/grouting adhesive
1. Multi-purpose, two-component, 100% solids, moisture-tolerant, structural adhesive.
  2. Conform to ASTM C881, Types I, II and V, Grade-2.
  3. Manufactured by:
    - a. Sika Corporation, Sikadur 32, Hi-Mod
    - b. Chemrex Inc. MasterFlow 649
    - c. Or equal.
- C. Epoxy grout paste adhesive
1. High modulus, two-component, moisture insensitive, 100 percent solids, thermo-setting modified polyamid epoxy compound.
  2. Paste form consistency capable of not sagging in horizontal or overhead anchoring configurations.
  3. Conform to ASTM C881 Type 1, Grade 3
  4. Heat deflection temperature: In excess of 130 degrees F.
  5. Manufactured by:
    - a. Chemrex Inc. Concrecive Paste LPL
    - b. Sika Corporation Sikadur Hi-Mod Series
    - c. Adhesive Technology Corporation Ultrabond 1350
    - d. Or equal,
- D. Epoxy grout for pressure grouting
1. Two-component, 100% solids, moisture-tolerant, epoxy adhesive. Low-viscosity, high-strength adhesive formulated specifically for injection grouting.
  2. Consistency as necessary to achieve complete penetration in hairline cracks and larger.
  3. Conform to ASTM C881 Type 1 and 2, Grade 1.
  4. Manufactured by:
    - a. Sika Corporation Sikadur 52
    - b. Chemrex Inc. Concrecive LV1
    - c. Adhesive Technology Corporation SLV 300 series
    - d. Or equal.
- E. Polymer concrete grout
1. Liquid binder and dry aggregate mixed together to make a mortar or grout of a consistency as necessary for the application.
  2. Liquid binder: Chemical and oil resistant, stress relieved, low modulus, moisture insensitive, two-component epoxy-resin compound.
  3. Consistency similar to lightweight oil for proper mixing with aggregate.
  4. Conform to ASTM C881 Type 3 Grade 1,

5. Aggregate:
  - a. Size and consistency compatible with recommendations of manufacturer of liquid binder for intended application.
  - b. Keep aggregate oven dry in sealed packages until time of mixing.
6. Manufactured by:
  - a. Sika Corporation Sikadur Lo-Mod series
  - b. Adhesive Engineering Concrecive 1470
  - c. Adhesive Technology Corporation 400 series
  - d. Or equal.

#### 2.04 PRESSURE GROUTING EQUIPMENT

- A. Mixer and holdover agitator tanks
- B. Designed to place grout at pressures up to 50 psi.
- C. Provide gages to indicate pressure grout pressure during application.
- D. Provide mixer with a meter capable of indicating to one-tenth of a cubic foot the volume of grout used.

### PART 3 - EXECUTION

#### 3.01 GENERAL

- A. Conduct mixing, surface preparation, handling, placing, consolidation, and curing for prepackaged grouts according to the instructions and recommendations of the grout manufacturer.
- B. Mix grouts in a mortar mixer.
- C. Bonding compound for use with grout is specified in Section 03301.
- D. Provide primer, if required, for polymer concrete, per manufacturer's recommendation.

#### 3.02 DRYPACK GROUT

- A. Roughen surfaces to be built up with drypack grout by brushing
- B. Clean, and coat surface with bonding compound in conformance to Section 03301 before the application of the grout.
- C. Apply drypack grout immediately following the application of the bonding compound in layers to the required thickness.
- D. Finish the surface smooth.
- E. Where construction joints are necessary, slope face of construction joints and clean and wet the existing grout before application is resumed.
- F. Cure drypack grout in accordance with Section 03301.
- G. Do not place drypack grout during freezing weather unless adequate protection is provided.



### 3.03 CEMENT GROUT

- A. Except for the specialized equipment for pressure grouting, mixing and placing apparatus use equipment similar to that normally used for cast-in-place concrete.
- B. Mix grout for a period of at least 1 minute.

### 3.04 NONSHRINK GROUT

- A. Place in accordance with manufacturer's instructions.

### 3.05 EPOXY GROUT

- A. Prime surface to be grouted in accordance with the grout manufacturer's instructions.

### 3.06 PRESSURE GROUTING

- A. Prior to grouting, Wash clean surfaces and holes to be grouted, prior to grouting.
- B. Washing is not required for grouting soil voids outside pipe cylinders or casing pipes.
- C. Once commenced, continue grouting to completion without stoppage.
- D. In case of breakdown of equipment, wash out the grouting system sufficiently to ensure fresh grout and adequate bond and penetration will occur upon restarting the grouting operation.
- E. Maintain grout pressure until grout has set.

### 3.07 GROUT SCHEDULE

- A. Use grout type indicated in the table below unless otherwise indicated.

Grout	Application
Drypack Cement Grout	Built-up surfaces, setting miscellaneous metal items and minor repairs.
Cement Grout	Filling nonbearing portions of equipment pads and pressure grouting.
Non-shrink Grout	Bearing surfaces of machinery and equipment bases, column base plates, and bearing plates, and setting handrail, guardrail, or fence posts in pipe sleeves.
Epoxy Grout	Reinforcing steel set in grout, repairing cracks in concrete, concrete repair.
Pressure Grout	Repairing cracks in concrete.
Polymer Cement Grout	Repair of concrete floors, patching.

**END OF SECTION**

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## **SECTION 05501**

### **ANCHOR BOLTS AND ANCHORING DEVICES**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Anchor bolts, concrete anchors, adhesive anchors, and other anchoring devices.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals

##### **1.03 SUBMITTALS**

- A. Comply with Section 01330.
- B. Product Data: Manufacturer's data for nuts, bolts, concrete anchors, chemical anchors and other fasteners.
- C. Catalog data and ICC reports for each type of anchor bolt.

##### **1.04 QUALITY ASSURANCE**

- A. For applications that require special inspection in accordance with building codes, coordinate the progress of the Work with the required inspection activities.

#### **PART 2 - PRODUCTS**

##### **2.01 MATERIALS**

- A. Unless otherwise specified or indicated on the Drawings, materials of construction for anchoring devices shall conform to the following:
  - 1. Anchor bolts and other anchoring devices, nuts and washers installed indoors: Type 304 stainless steel.
  - 2. Anchor bolts and other anchoring devices, nuts and washers installed outdoors or in locations exposed to wastewater: Type 316 stainless steel.
    - a. Locations exposed to wastewater includes:
      - 1) Below tops of walls of water-containing structures.
      - 2) Underside of roof, slab or walkways of enclosed water-containing structures.
      - 3) Dry side of walls on water-containing structures.

##### **2.02 CAST-IN-PLACE ANCHOR BOLTS**

- A. Locations for use of cast-in-place anchor bolts:
  - 1. In locations indicated on the Drawings.
  - 2. To anchor engine-driven equipment and equipment with motors 3 horsepower and larger.

- B. Cast-in-Place Anchor Bolts
  - 1. Material: Stainless steel conforming to ASTM A320.
  - 2. Minimum Length of Bolt: As indicated on the Drawings. When not indicated, provide bolt length such that the length of the embedded anchor is at least 10 bolt diameters.
  - 3. Termination of Embedded End of Bolt: Heavy hex head or double nut with standard flat washer.

## 2.03 CONCRETE ANCHORS

- A. Concrete Anchors: Drilled in place screw-type anchors with stainless-steel threaded stud body, integrated head and washer.
- B. Materials: Type 304 or Type 316 stainless steel, depending upon installed location.
- C. Code Compliance: Test in accordance with, and comply with requirements of, ASTM E488 and ICC-ES AC193.
- D. Manufacturers: One of the following or equal:
  - 1. Hilti KH-EZ Screw Anchor.
  - 2. ITW Redhead, Large Diameter Tapcon (LDT) Anchor.
  - 3. Dewalt Fasteners, Wedge-Bolt Screw Anchor.
  - 4. Simpson Strong Tie, Titen HD Heavy-Duty Screw Anchor.

## 2.04 STUDS

- A. Material: Conforming to ASTM A108 with 50,000 pounds per square inch minimum yield strength, and 60,000 pounds per square inch minimum tensile strength.
- B. Manufacturers: One of the following or equal:
  - 1. Nelson Stud Welding Company, S3L Shear Connectors or H4L Concrete Anchors.
  - 2. Stud Welding Products, Headed Concrete Anchors and Shear Connectors or Concrete Anchors.

## 2.05 ADHESIVE ANCHORS

- A. Applications: Use for bonding threaded rods and concrete reinforcing bars to hardened concrete and grouted cement masonry. Do not use in overhead applications, in chlorine gas environments, or where anchor may be exposed to machine oil or diesel oil.
- B. Code Compliance: Test in accordance with, and comply with requirements of, ASTM E488 and ICC-ES AC58.
- C. Materials
  - 1. Epoxy Adhesive: Two component, injectable epoxy adhesive.
  - 2. Concrete Reinforcing Bars: Grade 60.
  - 3. Threaded Rods: Type 304 stainless steel all-thread rod conforming to ASTM F593.
- D. Manufacturers: One of the following or equal:
  - 1. Hilti HVA Adhesive Anchor System.

2. ITW Redhead G6+ Adhesive Anchoring System.
3. Dewalt Fasteners PE1000+ Epoxy Anchoring System.
4. Simpson Strong Tie, SET-XP Epoxy Adhesive.

## **PART 3 - EXECUTION**

### **3.01 GENERAL ANCHORING REQUIREMENTS**

- A. Use equipment shop drawings, anchorage layout drawings, and anchor bolt layout templates to accurately position anchor bolts.
- B. Install anchor bolts, concrete anchors and other anchoring devices with at least 2 threads projecting beyond the nut, but no more than 1/2-inch projecting beyond the nut.
- C. Prior to installing nuts, coat threads of stainless steel bolts with material to prevent galling of threads.
  1. Manufacturers: One of the following or equal:
    - a. Never Seez Compound Corporation, Never-Seez.
    - b. Oil Research, Inc., WLR No. 111.
- D. Tighten nuts on anchor bolts, concrete anchors and other anchoring devices to the "snug-tight" condition, defined as tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary wrench.

### **3.02 CAST-IN-PLACE ANCHOR BOLTS**

- A. Do not use expansion type concrete anchors or adhesive anchors as substitution for cast-in-place anchor bolts.
- B. Accurately place anchor bolts to be embedded in concrete within the formwork and perpendicular to surface from which they will project. Secure in correct position while concrete is placed.
- C. Do not allow anchor bolts to touch reinforcing steel. Where anchor bolts are within 1/4 inch of reinforcing steel, isolate with a minimum of 4 wraps of 10 mil polyvinyl chloride tape in area adjacent to reinforcing steel.
- D. In anchoring machinery bases subject to heavy vibration, use 2 nuts, with 1 serving as a locknut.
- E. Where bolts are indicated on the Drawings for future use, first coat thoroughly with non-oxidizing wax, then turn nuts down full depth of thread and neatly wrap exposed thread with waterproof polyvinyl tape.
- F. Where indicated on the Drawings, set anchor bolts in metal sleeves having inside diameter approximately 2 inches greater than the bolt diameter and a minimum of 10 bolt diameters deep. Fill sleeves with grout when equipment is grouted in place.

### **3.03 CONCRETE ANCHORS AND ADHESIVE ANCHORS**

- A. Cast-in-place anchor bolts may be used in place of concrete anchors and adhesive anchors at Contractor's option.
- B. Installation:

1. Drill holes using concrete drill bits and impact type drill motors. Hole diameter shall be in accordance with the manufacturer's recommendations.
2. Clean drilled hole using compressed air to dislodge and remove drilling dust.
3. Accurately locate concrete anchors and set anchors with axis perpendicular to surfaces from which they will project.
4. Do not disturb adhesive anchors until cure time has elapsed.
5. Unless otherwise indicated on the Drawings or as required by structural calculations prepared by the equipment supplier, comply with minimum embedment lengths identified in the following table.

Minimum Embedment Lengths for Concrete and Adhesive Anchors

Diameter of Anchor or Bar, inches	Embedment Length for Concrete Anchors, inches	Embedment Length for Adhesive Anchors or Reinforcing Bars
1/4	1-3/4	As indicated on the Drawings
3/8	1-7/8	
1/2	2-1/4	
5/8	2-3/4	
3/4	3-1/4	
(1) Provide longer embedment where otherwise indicated		

**END OF SECTION**

## **SECTION 05520**

### **HANDRAIL**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Aluminum handrail.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section:
  - 1. Section 01330 – Submittals

##### **1.03 PERFORMANCE REQUIREMENTS**

- A. Design railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Aluminum Handrails: 60 percent of minimum yield strength.
- B. Structural Performance: Provide railings capable of withstanding the following loads and stresses:
  - 1. Handrails:
    - a. Uniform load of 50 pounds per lineal foot applied in any direction.
    - b. Concentrated load of 200 pounds applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Top Rails of Guards:
    - a. Uniform load of 50 pounds per lineal foot applied horizontally and concurrently with 100 pound load applied vertically downward.
    - b. Concentrated load of 200 pounds applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movement: Provide exterior railings that allow for thermal movements resulting from a change in surface temperature of 120 degrees.
- D. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

##### **1.04 SUBMITTALS**

- A. Comply with Section 01330.
- B. Product Data: Manufacturer's standard catalog data for mechanically connected railings.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- D. Calculations: Structural analyses signed and sealed by the qualified professional engineer, licensed in the State of Oregon, responsible for their preparation.
- E. Samples for selection of surface color or texture.

- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E894 and ASTM E935.

#### 1.05 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing through one source from a single manufacturer.

#### 1.06 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication. Indicate measurements on Shop Drawings.

### **PART 2 - PRODUCTS**

#### 2.01 MANUFACTURERS

- A. Manufacturers: One of the following or equal:
  - 1. Aluminum Pipe and Tube Railings:
    - a. AlumaGuard Corp.
    - b. CraneVeyor Corp.
    - c. Blum, Julius & Co., Inc.
    - d. Moultrie Manufacturing Company.

#### 2.02 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails, unless otherwise indicated.

#### 2.03 ALUMINUM

- A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.
- B. Extruded Bars and Tubing: ASTM B221, Alloy 6063-T5/T52.
- C. Extruded Structural Pipe and Round Tubing: ASTM B429, Alloy 6063-T6.
  - 1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.
- D. Drawn Seamless Tubing: ASTM B210, Alloy 6063-T832.
- E. Plate and Sheet: ASTM B209, Alloy 6061-T6.
- F. Die and Hand Forgings: ASTM B247, Alloy 6061-T6.
- G. Castings: ASTM B26/B26M, Alloy A356.0-T6.

#### 2.04 STAINLESS STEEL (NOT USED)



## 2.05 FASTENERS

- A. General: Provide the following:
  - 1. Aluminum Railings: Type 316 stainless-steel fasteners
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Anchors: Provide chemical or expansion-type anchors, fabricated from Type 316 stainless steel with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E488 conducted by a qualified independent testing agency.

## 2.06 FABRICATION

- A. Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with either welded or nonwelded connections, unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
- J. Form changes in direction by bending or by inserting prefabricated elbow fittings.

- K. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work, unless otherwise indicated.
- L. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- M. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.
  - 1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

## 2.07 FINISHES, GENERAL

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Stainless Steel Finishes (NOT USED)
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

## PART 3 - EXECUTION

### 3.01 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  - 3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

### 3.02 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in Part 2 "Fabrication" Article whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to 1 side, and locate joint within 6 inches of post.

### 3.03 ANCHORING POSTS

- A. For aluminum pipe railings, attach posts using fittings designed and engineered for this purpose.
- B. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

### 3.04 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so no evidence remains of correction work.

**END OF SECTION**

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## **SECTION 05530**

### **ALUMINUM GRATING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Aluminum grating and related appurtenances.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section:
  - 1. Section 01330 – Submittals

##### **1.03 SUBMITTALS**

- A. Comply with Section 01330.
- B. Grating: Submit shop drawings for the fabrication and installation of grating. Include dimensions, weights of each section, materials of construction, fabrication details, and fasteners.
- C. Grating Supports: Submit shop drawings showing support locations, dimensions, size and weight, and anchorage to the structure.
- D. Submit calculations demonstrating gratings meet specified load-bearing and deflection requirements for each type of grating and for each span.

##### **1.04 DESIGN REQUIREMENTS**

- A. Bearing Bars
  - 1. Rectangular bars, 3/16-inch thick, or I-bar, 1/16-inch thick web with 1/4-inch thick flange.
  - 2. Bar Depth and Spacing: Minimum 2 inches, or as determined by manufacturer to enable grating to support 180 pounds per square foot uniform live load on entire grating area, using an extreme fiber stress of 12,000 pounds per square inch.
    - a. Spacing Limitation: Not more than 1-3/8 inch center-to-center spacing between bearing bars.
  - 3. Top Edges of Bearing Bars: Grooved or serrated.
- B. Maximum Deflection Under Specified Loading: 1/240 of grating clear span maximum.
- C. Spacing of Main Grating Bars (Bearing Bars): Maximum of 1-1/8 inches clear between bars.
- D. Cross Bars: Swaged or pressure locked to bearing bars at maximum 4 inch spacing.
- E. Minimum Grating Depth: 2 inches.

##### **1.05 PROJECT CONDITIONS**

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with gratings by field measurements before fabrication.

- B. Coordinate installation of grating supports and grating frames. Furnish setting drawings and templates for installing anchors and items that are to be embedded in concrete or masonry.

## **PART 2 - PRODUCTS**

### **2.01 ALUMINUM GRATING**

- A. Manufacturers: One of the following, or equal:
  - 1. Grating Pacific, Inc.
  - 2. McNichols Company.
  - 3. Seidelhuber Metal Produces, Inc., Grooved I-Bar.
- B. Types: Swage locked with rectangular aluminum bars or swage locked I-bar aluminum grating.
- C. Materials of Construction
  - 1. Material for Grating, Shelf Angles, and Rebates: 6061-T6 or 6063-T6 aluminum alloy, except cross bars may be 6063-T5 aluminum alloy.
  - 2. Shelf Angle Concrete Anchors: Type 304 or Type 316 stainless steel.
  - 3. Grating Rebate Rod Anchors: 6061-T6 or 6063-T6 aluminum alloy.
- D. Fabrication: Fabricate grating to cover areas indicated on the Drawings.
  - 1. Fabricate grating in sections that are not wider than 3 feet and do not weigh more than 50 pounds.
  - 2. Design sections to enable installation and subsequent removal of grating around protrusions or piping.
    - a. Make cutouts in grating where required for equipment access or protrusion, including valve operators or stems, and gate frames.
    - b. Openings 6 inches and Larger: Lay out grating panels with edges of 2 adjacent panels located on centerline of opening.
    - c. Openings Smaller than 6 Inches: Locate opening at edge of single panel.
- E. Banding: Band ends of each grating section and around cutouts.
  - 1. End Banding: 1/8-inch less than height of grating, with top of grating and top edge of banding flush.
  - 2. Cutout Banding: Full depth of grating.
  - 3. Banding Material: Same material as grating.
- F. Hold-down Clips: Where an area requires more than 1 grating section to cover an area, clamp adjacent grating sections together at ¼ points with stainless steel hold-down clips of the shape indicated on the Drawings.

### **2.02 GRATING SUPPORTS**

- A. Seat Angles, Rebates and Beams
  - 1. Use same material as grating, coordinate depth and dimension with grating depth, including serrations.

2. Coat surfaces in contact with concrete with zinc rich primer.
  - a. Manufacturers: One of the following or equal:
    - 1) Benjamin Moore, Epoxy Zinc-Rich Primer CM18/19.
    - 2) Carboline Company, Carbozinc 621.
    - 3) Sherwin Williams Company, Corothane I GalvaPac Zinc Primer.
    - 4) Tnemec Company, Tneme-Zinc 90-97.
3. Horizontal bearing leg of seat angles and rebates: 2 inches minimum.
4. Allow 1/8 inch clearance between ends of grating and inside face of vertical leg of seat angles and rebates.
5. Grind sheared edges and welds to make smooth.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Install grating as indicated on the Drawings and in accordance with shop drawings.
- B. Install supports to provide solid support and even bearing of grating sections such that grating does not rock or wobble and movement does not occur under the design loading condition.
- C. Top surfaces of grating sections adjacent to each other shall line in same plane.
- D. Install aluminum plate or angles where necessary to fill openings at changes in elevation and at openings between equipment and grating.
- E. Install angle stops at ends of grating to prevent grating from sliding out of rebate or off support.

#### **END OF SECTION**

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**SECTION 09900**  
**COATING SYSTEMS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Furnishing labor, equipment and material necessary to perform surface preparation and to furnish and apply all paint, protective coatings and finishes as specified herein and/or as indicated on the Plans.

**1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 01999 – Reference Forms

**1.03 QUALITY ASSURANCE**

- A. Utilize quality assurance procedures and practices to monitor all phases of surface preparation, application and inspection throughout the duration of the project. Procedures or practices not specifically defined herein may be utilized provided they meet recognized and acceptable professional standards and are approved by the Construction Manager.
- B. Materials furnished and work accomplished under the Contract shall be subject to inspection by the Construction Manager. The Contractor shall be held strictly to the true intent of the Specifications in regard to quality of materials, workmanship, and diligent execution of the Contract.
- C. Work accomplished in the absence of prescribed inspection may be required to be removed and replaced under the proper inspection, and the entire cost of removal and replacement, including the cost of all materials which may be furnished by the City and used in the work thus removed, shall be borne by the Contractor, regardless of whether the work removed is found to be defective or not. Work covered up without the authority of the Construction Manager, shall, upon order of the Construction Manager, be uncovered to the extent required, and the Contractor shall similarly bear the entire cost of accomplishing all the work and furnishing all the materials necessary for the removal of the covering and its subsequent replacement, as directed and approved by the Construction Manager.
- D. Warranty
  - 1. Provide material and workmanship warranty for coatings of 18 months from date of final acceptance by the City.
  - 2. Complete the Extended Warranty Form (Section 01999).
  - 3. Any work found to be defective shall be repaired in accordance with the manufacturer's recommendations, this specification and to the satisfaction of the Construction Manager.

E. Coating Contractor

1. The Coating Contractor shall hold a current painting license and have a minimum five years practical experience in the application of specified products to surfaces at similar facilities.

1.04 REFERENCE PUBLICATIONS

A. This section references the following documents. They are a part of this section as specified and modified. In case of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.

1. SSPC – Society for Protective Coatings
2. ASTM – ASTM International
3. NSF/ANSI - NSF International

1.05 SUBMITTALS

A. Comply with Section 01330 and submit the following specific information:

1. Manufacturer's product data sheets.
2. Complete data on each type of paint and primer. This shall be done whether or not the product is named herein.
3. Manufacturer's published application instructions.
4. Color chart for each paint for color selection by City.

1.06 DELIVERY AND STORAGE

- A. Materials shall be delivered to the site in the manufacturer's sealed containers. Each container shall be labeled by the manufacturer, and the label shall be intact upon delivery. Labels shall give the manufacturer's name, brand, type of paint, batch number, color of paint, date of manufacture, storage life and instructions for reducing. Job mixing or job tinting may be done when approved by the Construction Manager and for sample colors.
- B. Store paint materials and equipment in a storage place protected from weather and excessive heat and cold. Take necessary precautions to reduce hazards to a minimum. Materials exceeding the storage life recommended by the manufacturer shall be removed from the site.

**PART 2 - PRODUCTS**

2.01 MANUFACTURERS

A. Specified products of the following manufacturers have been approved:

1. Tnemec Company Inc.
2. International Protective Coatings (IPC)
3. Dunn-Edwards Paints (D-E)

B. Products of other manufacturers demonstrating equivalence to performance requirements specified in Paragraph 2.02 will be allowed, subject to compliance with Section 01330.

## 2.02 MATERIALS

- A. Paint and coating materials furnished for each coating system shall be the products of a single manufacturer. Use only compatible materials in the work. Particular attention shall be directed to compatibility of primers and finish coats.
- B. The volatile organic content (VOC) of the applied coatings, as determined in accordance with ASTM D3960, shall comply with prevailing air pollution regulations.
- C. If the specified products are not available in formulations that meet applicable regulations on VOC levels at time of application, the Contractor shall submit for review products of equivalent quality and function that comply with regulations in effect at that time.
- D. No request for substitution of an "equal" will be considered which decreases the film thickness designated, the number of coats to be applied, solids content by volume, the general type of coating, paint, or primer, or the quantity, quality and type of ingredients in the coatings specified. Paints not listed in the specifications shall be submitted with certified ingredients analysis so that a complete comparison between specified and proposed paint may be made.

## 2.03 COLORS

- A. All colors and shades of colors of all coats of paint shall be as indicated or selected by the City. 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 City.

## PART 3 - EXECUTION

### 3.01 COATINGS SYSTEMS

- A. Shop Applied Prime Coat:
  - 1. Except as otherwise specified, prime coats shall be shop applied. Shop applied primer shall be compatible with the specific coating system and shall be applied at the minimum dry film thickness recommended by the manufacturer.
  - 2. Approved submittal data identifying the shop primer used shall be provided to the onsite finish coat applicator and to the Construction Manager before delivery of items to the jobsite.
  - 3. Damaged, deteriorated and poorly applied shop coatings that do not meet the requirements of this section, the field coating may consist of touching up the shop prime coat and then applying the finish coats to achieve the specified film thickness and continuity.
- B. Field Coats:
  - 1. Field coats shall consist of one or more finish coats to build up the coating to the specified dry film thickness. Unless otherwise specified, finish coats shall not be applied until the prime and intermediate coats have been inspected.

### 3.02 PREPARATION

- A. General
  - 1. Surfaces to be coated or painted shall be in the proper condition to receive the material specified before any coating or painting is performed.

2. No more sandblasting or surface preparation than can be coated or painted in a normal working day will be permitted.
3. Sharp edges, burrs and weld spatter shall be removed.
4. The following levels of surface preparation are subsequently referred to:
  - a. White Metal Blast Cleaning (SSPC-SP-5): Removal of all visible rust, mill scale, paint, and foreign matter by blast cleaning by wheel or nozzle (dry) using sand, grit, or shot.
  - b. Near-White Blast Cleaning (SSPC-SP-10): Blast cleaning nearly to white metal cleanliness until at least 95 percent of each element of surface area is free of all visible residues.
  - c. Commercial Blast (SSPC-SP-6): Blast cleaning until at least 67 percent of each element of surface area is free of all visible residues.
  - d. Brush-Off Blast Cleaning (SSPC-SP-7): Blast cleaning of film, rust, loose coatings, and providing a roughened surface for application of a new finish coat.
  - e. Solvent Cleaning (SSPC-SP-1): Removal of all grease, oil and dirt.
    - 1) Clean cloths and clean fluids shall be used in solvent cleaning.
    - 2) Cleaning and painting shall be scheduled so that dust and spray from the cleaning process will not fall on wet, newly painted surfaces.
    - 3) Hardware, electrical fixtures and similar accessories shall be removed or masked during preparation and paint operations, or shall otherwise be satisfactorily protected.
    - 4) Disconnected and move equipment adjacent to walls to permit cleaning and painting of equipment and walls; following painting, replaced and reconnected equipment.

**B. Metallic Surfaces**

1. Prepare metallic surfaces in accordance with applicable portions of surface preparation specifications of the Steel Structures Painting Council (SSPC) specified in each coating system. The solvent in solvent cleaning operations shall be as recommended by the manufacturer.

**C. Detailed Surface Preparation**

1. Surface preparations for each type of surface shall be in accordance with the specific requirements of each coating system.

**D. Existing Coating Systems**

1. Unless otherwise specified, existing or shop applied coating systems damaged by new construction shall be repaired and coated in accordance with the appropriate system specified for new work.
2. Contractor shall demonstrate that the existing coating is compatible with field coating by applying small test patches of specific paints over existing coatings. If the existing coating is not compatible with the field coat (it lifts or ripples), the existing coating shall be reprimed with a primer compatible with both the existing coating and the field applied paint, or replaced with the proper prime coat. The primer shall be as recommended by the manufacturer of the field applied paints.

### 3.03 APPLICATION

#### A. Workmanship

1. Each coat of paint shall be of the consistency as supplied by the manufacturer, or thinned if necessary, and applied in accordance with the manufacturer's written instructions.
2. Each coat shall be well brushed, rolled, or sprayed to obtain a uniform and evenly applied finish. Work shall be free from "runs", "bridges", "shiners", or other imperfections due to faulty intervals.
3. Particular care shall be taken to obtain a uniform, unbroken coating over all bolts, threads, nuts, welds, edges and corners.
4. Further, all weld splatter shall be removed and all welds neutralized with thinner.

#### B. Paint Properties, Mixing, and Thinning

1. Paint, when applied, shall provide a satisfactory film and smooth even surface, and glossy undercoats shall be lightly sanded to provide a surface suitable for the proper application and adhesion of subsequent coats.
2. Paints shall be thoroughly stirred, strained, and kept at a uniform consistency during application.
3. Coatings consisting of two or more components shall be mixed in accordance with the manufacturer's instructions.
4. Where necessary to suit the conditions of the surface, temperature, weather and method of application, the paint may be thinned immediately prior to use by the addition of not more than one pint per gallon of the proper thinner.
5. Unless otherwise specified, paint shall not be reduced more than necessary to obtain the proper application characteristics. Thinner shall be as recommended by the coating manufacturer.

#### C. Environmental Conditions

1. Paints shall be applied only to surfaces that are dry, and only under such atmospheric conditions as will cause evaporation rather than condensation.
2. Paint shall not be applied during rainy, misty weather, or to surfaces upon which there is frost or moisture condensation. During damp weather, when the temperature of the surface to be coated is within 10°F of the dew point, the surfaces shall be heated to prevent moisture condensation thereon.
3. Bare metal surfaces, except those which may be warped by heat, may be dehydrated by flame-heating devices immediately prior to paint application.
4. During painting, and for a period of at least 8 hours after the paint has been applied, the temperature of the surfaces to be painted, the painted surfaces, and the atmosphere in contact shall be maintained at or above 50°F and not less than 10°F above the dew point.
5. Fans or heaters shall be used inside enclosed areas where conditions causing condensation are severe.
6. Paint shall not be applied on surfaces hotter than 120°F.

D. Protection of Coated Surfaces

1. Items which have been coated shall not be handled, worked on, or otherwise disturbed, until the paint is completely dry and hard.
2. After delivery at the site of permanent erection or installation, shop coated metalwork shall be repainted or retouched with specified paint when it is necessary to maintain the integrity of the film.

E. Method of Paint Application

1. Only good, clean brushes and equipment shall be used; and all brushes, buckets, and spraying equipment shall be cleaned immediately at the end of each painting period.
2. If paint is applied by spray, the air pressure used shall be within the ranges recommended by both the paint and spray equipment manufacturers. Spray painting shall be conducted under controlled conditions, and the Contractor shall be fully responsible for any damage occurring from spray painting.
3. Care shall be exercised not to damage adjacent work during sandblasting operations. Stainless steel need not be sandblasted. Blasted surfaces shall be coated within 4 hours of being sandblasted. All dust shall be removed from the surfaces prior to painting.

F. Film Thickness and Continuity

1. Coating system thickness is the total thickness of primer and finish coats and does not include passivators or sealers.
2. The surface area covered per gallon of paint for various types of surfaces shall not exceed those recommended by the manufacturer.
3. The first coat (prime coat) on metal surfaces refers to the first full paint coat and not to conditioning, tie coats, sealers or other pretreatment applications.
4. Coatings shall be applied to the thickness specified, and in accordance with these specifications.
5. Unless otherwise specified, the average total thickness (dry) of any completed protective coating system on exposed metal surfaces shall be not less than 1.25 mils per coat, and the minimum thickness at any point shall not deviate more than 25 percent from the required average.
6. Unless otherwise specified, no less than two coats shall be applied.

G. Special Requirements

1. Hangers and supports shall be coated, except for the final coat, prior to the installation.
2. Except for those to be filled with grout, the underside of ungalvanized equipment bases and supports shall be coated with at least two coats of primer specified for system No. 5 prior to setting the equipment in place.
3. Bolts and bolt holes in flanges (such as those used with couplings or wafer type valves where holes and bolts as finally installed will be exposed to weather or moisture) shall be coated prior to assembly to prevent rusting of the unprotected metals.

H. Cleanup

1. Upon completion of coating, the Contractor shall remove surplus materials, protective coverings, and accumulated rubbish, and thoroughly clean all surfaces and repair any overspray or other paint related damage.

3.04 INSPECTION AND TESTING

- A. Notify the Construction Manager three (3) working days in advance of any field operations involving abrasive blast cleaning or coating applications.
- B. Coordinate work with the inspection, sampling and testing requirements of the Construction Manager
- C. The Construction Manager will perform such tests as are required to help ensure compliance with all phases of the surface preparation, and application of the coating systems.
- D. Inspection by the Construction Manager does not relieve the Contractor of the responsibility of compliance with all the requirements of these specifications.
  1. In cases of dispute concerning surface profiles, film thickness, film continuity (holidays), etc., the Construction Manager's measurements and tests shall be final. Abide by the Construction Manager's decisions and directives.
  2. Correct deficiencies in the continuity of the coating, or painting film or in the dry film thickness by applying additional coats as required, at the sole expense of the Contractor.

3.05 COATING SYSTEMS

- A. System No. 5, Exposed Metal – Mildly Corrosive:
  1. Application:
    - a. All exposed metal including pumps, pipe, valves, supports, and equipment, and other miscellaneous metal surfaces within the pump station, except electrical panels and other equipment which may be factory finished coated by the manufacturer.
    - b. The pumps shall be shipped with a compatible shop applied prime coat and the final coat shall be field applied as specified herein.
    - c. Where metal is galvanized, pretreat with Paint System 12.
    - d. Where metal is coated with fusion bonded epoxy, solvent clean, and scuff clean with 80 grit sand paper prior to coating application.
  2. Surface Preparation:
    - a. Solvent Cleaning (SP 1) and wire brush cleaning for shop applied primers. Power tool clean (SP3) for uncoated metal.
  3. Surface Preparation for Ductile Iron Pipe or Cast Iron surfaces
    - a. Solvent Cleaning
      - 1) Surfaces shall first be inspected and precleaned with appropriate solvents to remove grease, oil and other soluble contaminants.
      - 2) The preferred method of precleaning is through scrubbing of the surface with still bristle brushes soaked in solvent.

- 3) Prior to evaporation remove solvent by wiping with clean, lint-free cloth rags.
- 4) Remove rag residue (if any) with dry, oil-free compressed air.
- b. Surface Profile
  - 1) Measure surface profile (anchor pattern) in accordance with ASTM D4417, Method C.
  - 2) If surface profile is less than 1.5 mils then proceed with brush-off blast cleaning in accordance with No. 4.c below.
  - 3) If surface profile is 1.5 mils or greater then proceed with hand or power tool cleaning in accordance with No. 4.d.
- c. Brush-Off Blast Cleaning
  - 1) Remove all loose annealing oxides, loose rust, dirt and other foreign matter by compressed air nozzle abrasive blast cleaning using a fine abrasive.
  - 2) Remove any dust or other contaminants remaining after blasting with dry, oil-free compressed air or by vacuum cleaning.
  - 3) Recheck surface profile prior to painting.
  - 4) A profile depth of at least 1.5 mils is required.
- d. Hand or Power Tool Cleaning
  - 1) Remove all loose annealing oxides, loose rust, dirt and other foreign matter with the use of hand or power tools.
  - 2) Do not use cleaning tools that burnish or smooth the natural roughness (profile) of the cast iron surface.
  - 3) Remove any dust or other contaminants remaining after hand or power tool cleaning with dry, oil-free compressed air or by vacuum cleaning.

4. Material: Modified Epoxy.

- a. Converted epoxy containing rust-inhibitive pigments.

Application	Material	Cover
Primer	Polyamide, Epoxy Primer	1 coat, 5 MDFT
Finish	Polyamide, Anticorrosive Epoxy	1 coat, 5 MDFT

5. Standard of Quality:

- a. Tnemec Chembuild Series 135, Tnemec Epoxoline II, Series V69F; or equal.

6. Color selected by Construction Manager from color charts.

B. System No. 8, PVC – Interior and Exterior

1. Application:

- a. All exposed PVC pipe or other plastic surfaces shall be coated with System No. 8.

2. Surface Preparation:

- a. Hand sand plastic surfaces to be coated with a medium grit sandpaper to provide tooth for the coating system.



- b. Large areas may be power sanded or brush-off blasted, provided sufficient controls are employed so surface is roughened without removing excess material and adjacent surfaces are not damaged.
  - 3. Material:
    - a. Apply two coats of Acrylic Latex, 320 SFPGPC, to interior surfaces.
    - b. Apply one coat Polyurethane Enamel, 320 SFPGPC, to exterior surfaces.
  - 4. Color selected by Construction Manager from color charts. Chlorine piping shall be safety yellow.
- C. System No. 10, Underground Piping Appurtenances
  - 1. Application:
    - a. Unless otherwise specified or factory painted with an approved system, buried pipeline items, such as valves, couplings and bolts shall be coated with this system.
  - 2. Surface Preparation:
    - a. Apply only to clean, dry surfaces. Remove rust, paint and other foreign matter wire brushing or scraping.
  - 3. Material:
    - a. Tnemec - Two coats of 27WB Black, or equal; 8 mils each coat.
- D. System No. 12, Metal – Galvanized, Aluminum, Copper
  - 1. Application:
    - a. All galvanized metal. Aluminum, copper and brass to be painted shall be pretreated in accordance with this system.
  - 2. Surface Preparation:
    - a. Solvent cleaned in accordance with SSPC-SP-1, “Solvent Cleaning”. All surfaces shall be aggressively scarified to produce a profile between 1.0 and 1.5 mils.
  - 3. Material:
    - a. Apply one pretreatment coat of Tnemec Series 69, or equal, to a dry film thickness of 2 mil.
    - b. Next apply the recommended coating or paint for the particular surface to be painted.

### 3.06 SURFACES NOT TO BE PAINTED

- A. Unless otherwise specified, the following surfaces shall be left unpainted:
  - 1. Stainless Steel
  - 2. Machined Surfaces
  - 3. Glass
  - 4. Aluminum

### END OF SECTION

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**SECTION 10020**  
**WARNING SIGNS**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Informational and accident prevention signs.

1.02 REFERENCED SECTIONS

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 11000 – General Requirements for Equipment

1.03 DESIGN REQUIREMENTS

- A. Regulatory Compliance
  - 1. Accident Prevention Signs: Conform to design required by OSHA Section 1910.145 of Subpart J, Part 1910, Chapter XVII, Title 29 of the Code of Federal Regulations.
  - 2. Exit Signs: Conform with Section 1910.37(g) of the OSHA Safety and Health Standard for General Industry, Article 10, Section 10.113 of the Uniform Fire Code, and where applicable with local fire regulations.
- B. Size Requirements
  - 1. Sign sizes shall be as follows:
    - a. Size A: 14" x 20"
    - b. Size B: 10" x 14"
    - c. Size C: 7" x 10"
    - d. Size D: 24" x 24"
- C. Color Requirements
  - 1. Danger Signs:
    - a. Background: White.
    - b. Heading: White lettering in a red oval with a white border around the oval. Position oval in a black rectangular field in the upper portion of the sign.
    - c. Message: Black lettering.
  - 2. Caution Signs:
    - a. Background: Yellow.
    - b. Heading: Yellow lettering in a black rectangle. Position black rectangle in the upper portion of the sign.
    - c. Message: Black lettering on the yellow background.
  - 3. Safety Signs:
    - a. Background: White.

- b. Heading: White lettering in a green rectangle. Position green rectangle in the upper portion of the sign.
  - c. Message: Black lettering on the white background.
- 4. Warning Signs:
  - a. Background: Orange.
  - b. Heading: Black lettering in an orange diamond with black border forming the diamond. Position orange diamond in the upper portion of the sign.
  - c. Message: Black lettering.

#### 1.04 SIGN TYPES

##### A. Sign Types and Messages

Type	Message
<b>DANGER SIGNS</b>	
I	DANGER—HIGH VOLTAGE
II	DANGER—480 VOLTS
III	DANGER—CONFINED SPACE ENTRY
IV	DANGER—CONFINED SPACE—HAZARDOUS ATMOSPHERE
<b>CAUTION SIGNS</b>	
V	NON-POTABLE WATER—DO NOT DRINK
VI	CAUTION—CORROSIVE CHEMICALS
VII	CAUTION—HIGH TEMPERATURE
<b>SAFETY SIGNS</b>	
VIII	EAR PROTECTION REQUIRED BEYOND THIS POINT
IX	EMERGENCY EYEWASH AND SAFETY SHOWER
X	EMERGENCY EYE WASH
XI	NOT AN EXIT
<b>WARNING SIGNS</b>	
XII	WARNING—AUTOMATIC EQUIPMENT MAY START AT ANY TIME
XIII	WARNING—FOREIGN VOLTAGE
XIV	(NFPA hazardous material sign with appropriate chemical ratings)

#### 1.05 SUBMITTALS

- A. Comply with Section 01330.
- B. Samples: Submit 2 sets, typical of sign type. One set of samples will be retained by the CM, other returned to Contractor.
- C. Color samples of each color, 150 mm x 150 mm (6"x 6"). Show anticipated range of color and texture.
- D. Sample of typeface, arrow, and symbols in a typical full size layout.
- E. Manufacturer's Literature: Manufacturer's printed specifications, anchorage details, installation and maintenance instructions.

## **PART 2 - PRODUCTS**

### **2.01 GENERAL**

- A. Sign Lettering: Single stroke and contrasting in color with the background.
- B. Use standard and commonly accepted international symbols on signs with messages that include such symbols.
- C. Chain Mounted Signs: Provide signs with lettering on both sides.

### **2.02 MATERIALS**

- A. Signs shall be 0.100" thick fiberglass with embedded fade-proof legends.

### **2.03 SIGN SCHEDULE**

- A. Provide signs in accordance with the following schedule:

Location	Size	Type	Mount
Hose Bibbs	B	V	48" above floor
Automatic Equipment	B	XI	See also Section 11000

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Mount signs using round head stainless steel bolts or screws.
- B. Securely mount signs level, plumb and true to plane positions.

**END OF SECTION**

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## **SECTION 11000**

### **GENERAL REQUIREMENTS FOR EQUIPMENT**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. General requirements applicable to mechanical equipment and systems.
- B. Ensure mechanical equipment meets the requirements of this Section in addition to the specific requirements of the individual equipment specification Sections.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 01782 – Operation and Maintenance Information
  - 3. Section 01825 – Equipment and System Testing
  - 4. Section 01999 – Reference Forms
  - 5. Section 10020 – Warning Signs
  - 6. Section 11338 – Circular Secondary Clarifier Equipment

##### **1.03 GENERAL REQUIREMENTS**

- A. Equipment shall be of new construction and comply with the following requirements:
  - 1. Designed for all stresses that may occur during fabrication, transportation, erection, and during continuous or intermittent operations.
  - 2. Adequately anchored, leveled, aligned, and ready for operation without binding or overloading of critical components or motors.
  - 3. Installed with necessary appurtenances required for proper operation and installation in a neat and workmanlike manner.
  - 4. Tested by factory trained service mechanics or engineers.

##### **1.04 UNIT RESPONSIBILITY**

- A. Equipment systems shall be assembled as a unit by a single manufacturer responsible for the entire unit.
  - 1. Responsibility extends to selecting components of the system to assure compatibility, proper operation, and compliance with specified performance requirements.
  - 2. Unit responsibility does not relieve Contractor of responsibility to Owner for performance of the Work.

## 1.05 QUALITY ASSURANCE

### A. Arrangement

1. The arrangement of equipment shown on the Drawings is based upon information available at the time of design and is not intended to show exact dimensions peculiar to a specific manufacturer.
2. Some features of the illustrated equipment installation may require revision to meet actual equipment installation requirements.
3. Structural supports, foundations, connected piping, and valves shown may have to be altered to accommodate the equipment provided. Additional payment will not be made for such revisions and alterations.

### B. Balance: Fully assemble all rotating elements in motors, pumps, blowers and centrifugal compressors before performing static and dynamic balance. Where specified, submit balancing reports, demonstrating compliance with this requirement.

## 1.06 SUBMITTALS

### A. Comply with Section 01330.

### B. General: Provide separate submittals for each equipment item or group of related equipment items.

### C. Equipment Anchorage: Submit anchor bolt sizing calculations.

### D. Bearing Life Calculations: Submit bearing L-10 life calculations in accordance with AFBMA requirements.

## 1.07 OPERATION AND MAINTENANCE MANUALS

### A. Furnish operation and maintenance manuals for each equipment system in accordance with the Section 01782 requirements.

## 1.08 PROTECTION DURING SHIPMENT

### A. Shipping: Ship equipment in sealed, weather-tight, enclosed conveyances, and protected against damaging stresses during transport and handling.

### B. Bearing Housings: Wrap or otherwise seal to prevent contamination by grit and dirt, and tape closed ventilation and other types of openings.

### C. Repair any damaged materials to conform to the requirements of the Contract before the assembly is incorporated into the Work. The Contractor shall bear the costs arising out of dismantling, inspection, repair, and reassembly.

## PART 2 - PRODUCTS

## 2.01 PIPING CONNECTIONS ON EQUIPMENT

### A. Flanges on Equipment: Conform to dimensions and drilling specified in ANSI B16.1, Class 125 unless otherwise required by Division 15 pipe specifications or the Drawings.

### B. Pipe Flanges: Conform to dimensions and drilling specified in AWWA C207, Class D, 125 lb flanges provided on connection pipe.

### C. Threaded Flanges: Flat faced with standard taper pipe thread conforming to ANSI B1.20.1.



- D. Pipe Threads: Conform in dimension and limits of size to ANSI B1.1, coarse thread series, Class 2 fit.
- E. Flange Assembly Bolts and Nuts
  - 1. Heavy pattern, hexagonal head, carbon steel machine bolts with heavy pattern, hot pressed, hexagonal nuts conforming to ANSI B18.2.1 and B18.2.2.
  - 2. Threads: Unified Screw Threads, Standard Coarse Thread Series, Class 2A and 2B, ANSI B1.1.

## 2.02 BEARINGS

- A. Service: Unless otherwise specified, equipment bearings shall be oil or grease lubricated, ball or roller type, designed to withstand the stresses of the service specified.
- B. Rating
  - 1. L-10 Rating Life: Minimum 50,000 hours unless otherwise specified. Determine rating life using the maximum equipment operating speed.
  - 2. Determine rating in accordance with the latest revisions of AFBMA Methods of Evaluating Load Ratings of Ball and Roller Bearings.
  - 3. Where individual equipment Sections specify higher bearing life ratings, those requirements supersede the minimum bearing life specified above.
- C. Grease Lubricated Bearings
  - 1. Fit with easily accessible grease supply, flush, drain and relief fittings, except those bearings specified to be factory sealed and lubricated.
  - 2. Extend non-accessible grease fittings to an easily accessible location using 1/4-inch diameter stainless steel tubing as an extension tube.
  - 3. Grease supply fittings: Standard hydraulic Alemite or Zerk type.
- D. Oil Lubricated Bearings
  - 1. Equip with either a pressure lubricating system or a separate oil reservoir type system.
  - 2. Size oil lubrication systems to safely absorb the heat energy normally generated in the bearing under a maximum ambient temperature of 60°C.
  - 3. Equip with a filler pipe and an external level indicator gage.
- E. Incorporate bearing housings with sufficient cooling to maintain surface temperature at 65 degrees C or less for continuous operation at bearing rated load and a 50 degrees C ambient temperature, or install appropriate shielding on bearings that are accessible to touch.
- F. Bearing Isolators
  - 1. Provide for bearing where the shaft exits the bearing housing.
  - 2. Motor Bearings: Provide Inpro/Seal style VBX vapor blocking isolators.
  - 3. Gears: Provide Inpro/Seal “Double Runner” bearing isolator for shafts exiting the gear casing.
  - 4. Pumps, Blowers and Compressors: Provide Inpro/Seal style VBX blocking bearing isolators where shafts exit casings/housings.

5. Pillow Block Bearings: Provide Inpro/Seal “Pop-In” style bearing isolators.

## 2.03 DRIVE COMPONENTS

### A. V-Belt Drives

1. Design with sliding base or other suitable tension adjustment.
2. Design with service factor of at least 1.6 at maximum speed.
3. Statically balance sheaves. In addition, dynamically balance sheaves that will operate at peripheral speed of more than 5,500 feet per minute.
4. Belts: Provide anti-static belts when explosion-proof equipment or environment is specified.

### B. Gear Reducers

1. Provide drives with nominal input horsepower rating equal to or greater than the nameplate horsepower of the drive motor.
2. Provide gear drives manufactured in accordance with AGMA Class II service requirements.

## 2.04 SHAFT COUPLINGS

- A. Type and Rating: Non-lubricated, designed for a minimum of 50,000 hours operating life.
- B. Equipment with a driver greater than 1/2 horsepower, and where the input shaft of a driven unit is directly connected to the output shaft of the driver, shall have its two shafts connected by a flexible coupling which can accommodate angular misalignment, parallel misalignment and end float, and which cushions shock loads and dampens torsional vibrations.
- C. Provide couplings recommended by the coupling manufacturer for the specific application, considering horsepower, speed of rotation, and type of service.
- D. Install couplings in conformance to the manufacturer's instructions.

## 2.05 GUARDS AND CAUTION SIGNS

### A. Guards

1. Enclose exposed moving parts with guards that meet the requirements of federal and state OSHA requirements.
2. Enclose drive shafts to at least 7 feet above floors or operating platforms.

### B. Materials

1. Fabricate guards of 14 gauge steel and expanded metal screen to provide visual inspection of moving parts without removal of the guard.
2. Galvanize after fabrication and paint with the equipment.
3. Fasteners: Type 304 stainless steel.

### C. Warning Sign

1. Provide warning signs near equipment with moving parts that operate automatically or by remote control.
2. Provide warning signs with wording, size and colors specified in Section 10020.

## 2.06 NAMEPLATES

### A. Nameplates

1. Provide on each item of equipment with the specified equipment name or abbreviation and equipment number.
2. Engrave or stamp (not painted) on stainless steel and fastened to the equipment in an accessible location with stainless steel screws or drive pins.

## 2.07 SPARE PARTS AND LUBRICANTS

### A. Spare Parts: Provide for each item of mechanical, electrical, and instrumentation equipment a supply of spare parts and special tools required for the starting, testing, adjustments, and initial operation. Pack spare parts required by individual equipment specifications:

1. Pack spare parts with individual weights less than 50 pounds in a heavily constructed painted wood box with hinged cover and a locking clasp.
2. Provide a typed inventory of spare parts stapled to the underside of the cover.
3. Tag and wrap each part in a waterproof container. Spare bearings shall be encapsulated in an airtight plastic film.

### B. Lubricants: Provide for each item of mechanical equipment of the type recommended by the equipment manufacturer a supply of the lubricant for startup, testing, and initial operation.

1. Provide a list showing the required lubricants for each item of mechanical equipment. List estimated quantity of lubricant needed for a full year's operation, assuming the equipment will operate continuously.
2. Lubricants shall be products of the Owner's current lubricant supplier.
3. Limit the various types of lubricants by consolidating them, with the equipment manufacturer's approval, into the least number of different types.

## 2.08 ANCHOR BOLTS

### A. See Section 11338.

## 2.09 FACTORY APPLIED COATINGS

### A. Ship each item of equipment to the site of the work with a shop applied prime coating.

### B. Finish Painting of Motors: Factory-apply finish coats using manufacturer's standard coating.

## 2.10 SPECIAL TOOLS AND ACCESSORIES

### A. Furnish with each piece of equipment all tools, instruments, or accessories of a special nature that are required to assemble, disassemble, maintain, or repair any item of equipment.

1. Tag and mark each piece indicating their service and the piece of equipment for which their use is intended.
2. Include a list and description or pictorial representation of all special tools required for a given piece of equipment for insertion into the equipment operation and maintenance manual.

## 2.11 FASTENERS AND DIELECTRIC ISOLATION

- A. Fasteners for Aluminum: Stainless steel.
- B. Isolate steel surfaces, other than stainless steel, from aluminum with stainless steel, neoprene, non-metallic washers or other acceptable material.
- C. Dissimilar Metals: Protect from galvanic corrosion by means of pressure tapes, coatings, or isolators.

## **PART 3 - EXECUTION**

### 3.01 INSTALLATION

- A. Install, align and test each item of equipment within the tolerances recommended by the equipment manufacturer.
- B. When specified in individual Sections, install and test equipment under the direction of installation engineers who have been factory trained by the equipment manufacturer.
- C. Perform all work in accordance with manufacturer's recommendations.

### 3.02 QUALITY CONTROL

- A. Test equipment in accordance with Section 01825 and the individual equipment Section.
- B. Furnish written certification from the equipment manufacturers that each item has been installed, aligned, and tested correctly and that the installation meets the manufacturer's requirements for efficient, trouble-free operation. Utilize Manufacturer's Installation Certification Form provided in Section 01999.
- C. Equipment manufacturer's certification shall not be construed as relieving the Contractor of his overall responsibility for this portion of the work.

### **END OF SECTION**

**SECTION 11002**  
**EQUIPMENT MOUNTING**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Equipment mounting requirements, including fabricated steel equipment bases, concrete equipment pads, supports, anchorage, and accessories.

1.02 REFERENCED SECTIONS

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 05501 – Anchor Bolts and Anchoring Devices
  - 3. Section 09900 – Coating Systems

1.03 QUALITY ASSURANCE

- A. Provide supports, anchorage, and equipment mounts that are sized and designed to resist the calculated forces and that are in accordance with the manufacturer's recommendations, the current International Building Code (IBC), and industry standards requirements.

1.04 DESIGN REQUIREMENTS

- A. Design equipment mounts and anchorages to resist the minimum lateral force required by the latest edition of the IBC, the manufacturer of the equipment, or a lateral seismic force of 60% of the operating weight of the equipment, whichever is greater.
- B. Equipment anchor bolt sizes shown on the Drawings are the minimum required size.
- C. Equipment anchorage design and calculations shall be prepared and signed by a civil or structural engineer currently registered in the state where equipment is installed.

1.05 MOUNTING REQUIREMENTS

- A. Mount equipment and driver on a common fabricated steel baseplate with ample rigidity to support equipment and maintain shaft alignment without excessive deflection.
- B. Mount equipment baseplates on concrete equipment pads.

1.06 SUBMITTALS

- A. Comply with Section 01330.
- B. Shop Drawings: Provide drawings of equipment bases and anchorage details.
- C. Anchorage Calculations: Submit stamped and signed anchor bolt sizing calculations.

**PART 2 - PRODUCTS**

2.01 ANCHOR BOLTS AND CONCRETE ANCHORS

- A. Provide anchor bolts and concrete anchors in accordance with Section 05501.

## 2.02 CONCRETE EQUIPMENT PADS

- A. Construct concrete pedestals at least 6 inches wider and longer than the steel or cast base so that the distance between the anchor bolts and the edge of concrete is at least 3 inches.
- B. Unless otherwise shown or specified, all conduits, piping connections, drains, etc. shall be enclosed by the concrete base.
- C. Shape concrete pedestals to drain away from the base.
- D. Allow concrete to cure 14 days or until the concrete has cured to 75 percent of its specified compressive strength before placing equipment on the concrete pedestal.
- E. Do not start equipment placed on the concrete pedestal until the concrete has cured for 28 days or to 100 percent of its specified compressive strength.

## 2.03 STRUCTURAL STEEL EQUIPMENT BASES

- A. Provide structural steel bases with thickened steel pads for doweling.
  - 1. Fabricate equipment base using continuous welds to seal seams and contact edges between steel members.
  - 2. Grind welds smooth.
- B. Design equipment bases with perimeter steel beams, intermediate stiffeners and baseplate.
  - 1. Provide perimeter steel beams with minimum depth equal to 1/10th of the longest dimension of the base.
  - 2. Beam depth need not exceed 14 inches provided that the baseplate deflection is kept within acceptable limits to minimize misalignment, as determined by the manufacturer.
- C. Provide grout holes for the bases of equipment where vibration isolation is not specified.
- D. Provide minimum 1-inch thick steel mounting baseplate for equipment with drivers 20 horsepower and larger.
- E. Shop-apply prime coat prepared in accordance with the requirements of Section 09900 and compatible with the finish coatings

## PART 3 - EXECUTION

### 3.01 GENERAL

- A. Connect piping to equipment with flexible connections and/or expansion joints such that the intended use of these joints is maintained in the piping system.
- B. Coordinate the location of electrical conduit and piping penetrations within the concrete pad and equipment base.
  - 1. Stub-up penetrations on the same side of the equipment as required for connection to the equipment.
  - 2. Locate equipment drains for proper drainage away from equipment.

### 3.02 EQUIPMENT MOUNTING

- A. Mount equipment on equipment baseplates using stainless steel shims so that equipment and driver are level in both directions and mounted within machined areas on baseplate. Do not use wedges to obtain level and alignment.
- B. Utilize templates for placement of anchor bolts prior to placing concrete for equipment pad.
- C. Apply a non-seize or non-galling compound on the threads of anchor bolts and concrete anchors.

### 3.03 SHAFT ALIGNMENT

- A. After the complete unit has been installed on the equipment pad and leveled, check the factory shaft alignment by disassembling coupling and measuring angular and parallel orientations.
- B. Use reverse-indicator dial or laser type alignment equipment to align shafts to within the manufacturer's required tolerance. Allow for thermal expansion, spacer coupling length and other factors that affect proper shaft alignment.

### 3.04 GROUTING EQUIPMENT BASED

- A. After alignment has been completed, tighten anchor bolts and grout between equipment base and equipment pad. Use non-shrink and non-ferrous grout no less than 7/8 inch and no more than 1-5/8-inches thick.
- B. Allow 48 hours for grout to harden and then remove jacking screws. Re-check torque on anchor bolts and re-check shaft alignment, making corrections as necessary.

**END OF SECTION**

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**SECTION 11060**  
**ELECTRIC MOTORS**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Low-voltage alternating current induction motors, 250 horsepower or less.
- B. This section does not specify medium voltage (over 600 volts) motors and specialty motors such as submersible motors, hoist motors, valve operator motors or torque rated motors.
- C. Unless specified otherwise, require electric motors to be provided by the manufacturer of the driven equipment per of Section 11000.
- D. Unless specified otherwise in the particular equipment specifications, comply with these specifications. Electrical motors are being provided by the Secondary Clarifier Equipment Manufacturer as Owner Provided Equipment. See Specification 11338.

**1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 01782 – Operation and Maintenance Information
  - 3. Section 01999 – Referenced Forms
  - 4. Section 11000 – General Requirements for Equipment

**1.03 QUALITY ASSURANCE**

- A. Unit Responsibility (Not Used)
- B. Product Delivery, Storage, and Handling
  - 1. Comply with manufacturer’s recommendations.
- C. Basic Standards
  - 1. Manufacture per UL 674, UL 1004, NEMA Standard MG 1, and the requirements specified.

**1.04 ENVIRONMENTAL CONDITIONS**

- A. Refer to individual equipment sections and drawings for installation locations.

**1.05 SUBMITTALS**

- A. Comply with Section 01330.
- B. Include a copy of the contract document control diagrams and process and instrumentation diagrams, with addenda updates, that apply to the equipment in this section.
  - 1. Mark to show specific changes necessary for the equipment proposed in the submittal.
  - 2. If no changes are required, mark the drawing or drawings “No Changes Required”.

3. Failure to comply with this paragraph is sufficient cause to reject the entire submittal.

C. Not Used

#### 1.06 DESIGN REQUIREMENTS (NOT USED)

#### 1.07 WARRANTY (NOT USED)

- A. Provide two-year warranty from date of substantial completion unless manufacturer's standard warranty is longer.
- B. Complete the Extended Warranty Form in Section 01999.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION**

#### 3.01 TESTING

- A. Perform winding insulation resistance and current imbalance testing as specified in Division 16.
- B. Test for correct rotation during preoperational checkout.

**END OF SECTION**

## **SECTION 11338**

### **CIRCULAR SECONDARY CLARIFIER EQUIPMENT (CIRCULAR PLOW TYPE) OWNER PROVIDED EQUIPMENT**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

- A. This section covers circular clarifier equipment that was pre-purchased by the Owner for assembly and installation (by the Contractor) within an existing circular secondary clarifier tank at the City of Cottage, Oregon Wastewater Treatment Plant (WWTP). This section is included in its entirety to specify the requirements for assembly and installation of the equipment. The Contractor will also be responsible for Part 3 of this specification including coordinating with the equipment supplier and conducting the testing.
- B. Appendix B contains the shop drawings provided by the equipment supplier, ClearStream Environmental. The equipment will be stored onsite in the location shown on the Drawings. The shop drawings take precedent over any information provided in this specification and the Contract Documents.
- C. The Contractor and Construction Manager shall inspect the secondary clarifier equipment prior to beginning installation of the equipment. This inspection shall occur within 10 days of the Contractor Notice-to-Proceed.
- D. The existing Secondary Clarifier No. 1 is a center feed, peripheral overflow design with an outboard concrete launder and center sludge hopper configuration.
- E. The equipment shall be designed for gravity separation of mixed liquor solids from the activated sludge process and shall be specifically designed for installation within the existing Secondary Clarifier No. 1 and existing conditions shown in the as-builts provided and as described herein.
- F. The clarifier mechanism shall be of the center drive type, supported on a stationary influent column with the flow entering at the bottom of the influent column and flowing upward into the energy dissipating inlet. The flow shall then proceed into the hydraulic flocculating feedwell through tangential gates near the water level for further energy dissipation and settling. The clarifier mechanism shall be designed to remove settled sludge from the center hopper at the bottom of the tank and floating scum from the surface of the tank.
- G. The equipment specified herein includes sludge and scum collection equipment, scum troughs, scum baffles, weir plates, drive equipment, bridge and walkway for access to the drive equipment, and miscellaneous appurtenances as specified.
- H. Equipment shall be furnished complete with all mechanical and electrical components and accessories required for proper installation and operation, including complete drive units and controls; and any additional materials or construction required by the manufacturer to meet the requirements of the pre-purchase package.
- I. The supplier shall furnish a system that is fully coordinated and operating properly. All items required for a complete and properly operating system shall be provided, whether specifically called for or not.

- J. Equipment tag numbers:
  - 1. Secondary Clarifier No. 1: 60-SDR-01

## 1.02 REFERENCED SECTIONS

- A. The following Sections are referenced in this Section:
  - 1. Section 01330 – Submittals
  - 2. Section 01782 – Operation and Maintenance Information
  - 3. Section 01825 – Equipment and System Testing
  - 4. Section 01999 – Reference Forms
  - 5. Section 05520 – Handrail
  - 6. Section 05530 – Aluminum Grating
  - 7. Section 11000 – General Requirements for Equipment
  - 8. Section 11060 – Electric Motors

## 1.03 REFERENCES

- A. This section contains references to the documents listed below. They are a part of this section as specified and modified. Where a referenced document cites other standards, such standards are included as references under this section as if referenced directly. In the event of conflict between the requirements of this section and those of the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids). 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.
- C. The following is a list of standards that may be referenced in this section:
  - 1. American Bearing Manufacturers Association (ABMA).
  - 2. American Gear Manufacturers Association (AGMA):
    - a. 2001, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.
    - b. 2004, Gear Materials, Heat Treatment and Processing Manual.
    - c. 6022, Design Manual for Cylindrical Wormgearing.
    - d. 6034, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors.
    - e. 9005, Industrial Gear Lubrication.
  - 3. American Institute of Steel Construction (AISC).
  - 4. American Iron and Steel Institute (AISI).
  - 5. American Society of Mechanical Engineers (ASME): B29.100, Precision Power Transmission, Double-Pitch Power Transmission, and Double-Pitch Conveyor Roller Chains, Attachments, and Sprockets.

6. American Water Works Association (AWWA): C200, Steel Water Pipe – 6 In. (150 mm) and Larger.
7. American Welding Society (AWS):
  - a. D1.1/D1.1M, Structural Welding Code – Steel.
  - b. QC 1, Standard for AWS Certification of Welding Inspectors.
8. American Society for Testing and Materials (ASTM) International:
  - a. A36/A36M, Standard Specification for Carbon Structural Steel.
  - b. A48/A48M, Standard Specification for Gray Iron Castings.
  - c. A148/A148M, Standard Specification for Steel Castings, High Strength, for Structural Purposes.
  - d. A283/A283M, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
  - e. A285/A285M, Standard Specification for Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength.
  - f. A536, Standard Specification for Ductile Iron Castings.
9. National Electrical Manufacturers Association (NEMA):
  - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
  - b. MG 1, Motors and Generators.

#### 1.04 DEFINITIONS

- A. **Alarm Torque:** The torque at which an alarm sounds to serve as a warning of increased torque loading. The alarm torque is defined to be equal to 90 percent of the continuous operating torque.
- B. **Continuous Operating Torque:** The continuous operating torque is defined as the AGMA design torque, which is the torque load that is assumed to be continuously applied to the sludge and scum collection equipment by the drive system through a 24-hour operating period, 365 days per year for a 20-year life.
- C. **Cutout Torque:** The torque load at which a motor cutout switch is activated to shut down the unit. The cutout torque is defined to be not less than 120 percent of the continuous operating design torque.
- D. **Energy Dissipating Inlet (EDI):** A device mounted at the center discharge column designed to dissipate the kinetic energy of the flowing wastewater as it is discharged from the center column inlet ports. Energy is dissipated through the dual effects of the energy dissipating inlet and the flocculation well.
- E. **Momentary Peak Torque:** The maximum or peak torque of the drive unit assumed to be equal to twice the calculated AGMA torque rating of the spur gear set or 3 times calculated AGMA torque rating of the worm gear set, whichever is lower.
- F. **RAS:** Return Activated Sludge.
- G. **Set:** Equipment necessary to completely furnish 1 clarifier.
- H. **Sidewater Depth:** Vertical distance from the normal water surface elevation in the clarifier to the top of the base slab as measured at the outer wall of the clarifier.
- I. **Slenderness Ratio:** Ratio of unbraced length to least radius of gyration.

- J. **Submerged Metal:** Metal below gear head drive and plane 18 inches above weir elevation indicated.

## 1.05 DESIGN REQUIREMENTS

### A. Existing Secondary Clarifier Characteristics

1. Equipment shall be suitable for installation within an existing secondary clarifier with the following physical dimensions:

Item	Value
Nominal Internal Diameter, feet	85
Approximate Sidewater Depth, feet	12
Approximate Slope of Clarifier Bottom Slab (inches/foot)	1" per foot
Maximum allowable headloss through the clarifier equipment at maximum inlet flow, inches	12
Freeboard at maximum inlet flow, feet	1.76
Notes Sidewall depth and bottom slope have been obtained from original design drawings for each clarifier and have not been field verified. Repairs will be made to the clarifier floor after procurement of the mechanism. The Contractor will be responsible for making the repairs compatible with the mechanism as defined in this Section and installing the mechanism.	

### B. Operating Conditions

1. Equipment shall perform in accordance with the following operating conditions:

Item	Value
Maximum inlet flow, mgd (peak flow with maximum return sludge return)	12
Minimum inlet flow, mgd (minimum flow with minimum return sludge return)	0.4
Maximum return sludge flow, mgd	2.0
Minimum return sludge flow, mgd	0.2
Maximum center column mixed liquor inlet port headloss at maximum inlet flow, feet	0.2
Design SVI, mL/g	200
Mixed liquor suspended solids concentration range, mg/L	1,850 – 3,200
Maximum mechanism tip speed, feet per minute	8
Mechanism Rotation	Clockwise
Sludge viscosity, N-sec/m <sup>2</sup>	0.001 – 0.01

### C. Sludge and Scum Removal

- Clarifier equipment shall collect and convey settled sludge to the center sludge pit.
- Clarifier equipment shall collect, convey, and discharge floating scum from the surface of the clarifier to defined area at outside perimeter of the unit.
- Capable of withstanding, without failure or permanent deformation of any part, Momentary Peak Torque rating as defined herein.

- D. Drive Mechanism:
  - 1. All drive gears and bearings shall be located above water level and all gearing shall be completely enclosed and grease or oil lubricated.
  - 2. Easy removal of internal gears, balls, and strip liners without walkway bridge removal.
- E. Design Running Torque:
  - 1. 15,000 foot-pounds minimum foot pounds minimum.
- F. Rotational Speed:
  - 1. Between 0.03 and 0.025 rpm.

## 1.06 STRUCTURAL DESIGN CRITERIA

- A. General
  - 1. In accordance with Oregon Structural Specialty Code (OSSC), tanks, mechanical and electrical components, and other elements of the Work that are permanently attached to structures shall be designed and constructed to transfer the component seismic forces specified in ASCE 7, Chapter 13 to the structure.
  - 2. Seismic attachments braces, and anchorages shall be designed in accordance with the provisions of the OSSC and the site-specific seismic criteria as follow:
    - a. Site-Specific Spectral Response Coefficients
      - 1) Short Period Mapped Maximum Considered Earthquake, 5 Percent Damped:  $S_s=0.661g$
      - 2) Short Period Mapped Maximum Considered Earthquake, 5 Percent Damped:  $S_1=0.386g$
      - 3) Short Period Design Spectral Response Acceleration, 5 percent Damped:  $S_{DS} = 0.560$
      - 4) 1 Second Period Design Spectral Response Acceleration, 5 percent Damped:  $S_{D1} = 0.508$
    - b. Site Class: D
    - c. Seismic Design Category: D, unless noted otherwise
    - d. Risk Category: III, unless noted otherwise
    - e. Component Importance Factor,  $I_p$ :
      - 1) Mechanical and Electrical Equipment: Use 1.25.
      - 2) Tanks and Tank Anchorage: Use 1.25.
      - 3) Components that contain hazardous materials: Use 1.5.
      - 4) Components that are required for life safety: Use 1.5.
    - f. Components that must remain functional after an earthquake, such as fire protection sprinkler systems: Use 1.5. Do not use more than 60 percent of the weight of tanks and mechanical and electrical equipment for designing anchors for resisting overturning due to seismic forces.
    - g. Do not use friction to resist sliding due to seismic forces.

- B. Equipment Design drive cage, each sludge rake arm, and associated supports and connecting members to transmit and/or carry all loads and stresses associated with 200% of the continuous operating torque at the AISC allowable stresses. Do not exceed AISC allowable stresses by more than 33 percent under this loading condition. In addition to the specified operating loads, each member shall be designed to withstand a point load of 200 pounds applied perpendicular to its weak axis at the midpoint between its support areas.
  - 1. Size structural members to accommodate the momentary peak torque without exceeding a deflection of  $L/100$  where  $L$  is the length of the structural member.
- C. Drive Cage Design
  - 1. Design drive cage as a box truss with connections for the two sludge rake arms and feedwell supports.
  - 2. Design drive cage to withstand 200 percent of the continuous operating torque without overstressing the members. Consider the loading to develop the continuous operating torque as a uniform load applied to each rake arm.
  - 3. Minimum Member Size: 2-inch by 2-inch by 1/4-inch angles.
- D. Sludge Rake Arm Design
  - 1. Design rake arms as a steel truss using triangular or box truss construction.
- E. Influent Column Design
  - 1. Design center influent column to support the drive mechanism, the sludge collection mechanism, scum skimmer arms, utility piping, access bridge, and related appurtenances.
- F. Energy Dissipating Inlet Design
  - 1. Design the EDI and associated supports to support the weight of the EDI plus the weight of water to a depth of 2 inches within the EDI.
- G. Scum Removal Mechanism
  - 1. Design scum trough with sufficient rigidity to limit deflection and sagging to a maximum of 1/2-inch such that skimmer wiper contacts trough along entire length of wiper.
  - 2. Design scum trough and associated supports for all dead loads and live loads encountered during operation. Design scum trough and supports for the following two loading conditions:
    - a. Trough is plugged and full of water and clarifier is empty.
    - b. Trough is empty and clarifier is full of water.
  - 3. Support scum trough from concrete wall of clarifier. Connect scum trough to scum baffle but do not transfer load to the scum baffle.
- H. Access Bridge Design
  - 1. Design access bridge and operating platform for a live load of 60 lbs/ft<sup>2</sup>. Deflection under full live load and dead load shall not exceed 1/360 of the span.
  - 2. The access bridge shall span one half of the diameter of the clarifier.



## 1.07 PROJECT CONDITIONS

### A. Environmental Project Conditions:

1. Installation in a wastewater treatment plant.
2. Moderate quantities of commercial and industrial waste.
3. Exposure to industrial solvents and petroleum products.
4. Operation at 628 feet above mean sea level.
5. Ambient Air Temperature:
  - a. Maximum: 105 degrees Fahrenheit
  - b. Minimum: -5 degrees Fahrenheit.
6. Wastewater temperature:
  - a. Maximum: 80 degrees Fahrenheit
  - b. Minimum: 50 degrees Fahrenheit.

## 1.08 SUBMITTAL

### A. Submit within 60 days of notice to proceed in accordance with Section 01330; include the following information:

1. Completed Certificate of Unit Responsibility (Section 01999) attesting that the manufacturer accepts, unit responsibility in accordance with the requirements of this Section and Section 11000. No other submittal material will be reviewed until the certificate has been received and found to be in conformance with these requirements.
1. Product Data: Submit manufacturer's standard catalog data, descriptive literature, motor and drive system data, parts list, and specifications describing system components.
2. A copy of this specification section, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Sections to be marked-up and submitted shall include:
  - a. Section 05520 – Handrail
  - b. Section 05530 – Aluminum Grating
  - c. Section 11000 – General Requirements for Equipment
  - d. Section 11060 – Electric Motors
  - e. A check mark shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph referenced to a detailed written explanation for requesting the deviation. The City shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Manufacturer with the specifications. Failure to include a copy of the marked-up specification sections, 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. Shop Drawings

- a. Provide general arrangement drawings showing the entire assembly. Include a materials list and descriptions of major components of the clarifier mechanism. Indicate:
  - 1) Size, thicknesses, and material designation for structural members.
  - 2) Dimensions.
  - 3) Details of connections to the concrete structure for the access bridge, scum trough, and center column.
  - 4) Descriptive information and electrical schematic for torque overload device.
  - 5) Location of piping connections.
- b. Submit manufacturer's equipment mounting instructions, requirements and detailed drawings for the installation of the secondary clarifier.
- c. Electrical control schematics for motors and process and instrumentation diagrams.

4. Calculations

- a. Structural calculations identifying static, dynamic and torque reaction loads to be transferred into the structure at the center column and the access bridge support location.
- b. Structural design calculations for collector mechanism components, access bridge, bridge handrail, and other components substantiating the ability of each component to withstand the stresses imposed at the loads and torque conditions described in this Section.
- c. Sludge transport calculations substantiating withdrawal rates, headlosses, the sludge scraper blade design, rake tip speed, and floor slope and general sizing of equipment.
- d. Anchor bolt design calculations.
- e. Hydraulic calculations and process performance calculations for sizing the center column and discharge ports; EDI and EDI outlets; and flocculation well, demonstrating compliance with the specified requirements.
- f. Calculations documenting the AGMA rating of the drive unit and life of the main bearing.

5. Testing

- a. Factory Tests: Provide certified shop inspection reports indicating that all components of the secondary clarifiers have been factory-tested in accordance with the manufacturer's requirements and that the components meet or exceed the requirements of this Section.
- b. Proposed on-site testing and start-up procedures, including sketches and calculations for specified tests.

6. Manufacturer's Experience and Qualifications
  - a. Installation list.
  - b. Manufacturer qualifications.
7. Documentation
  - a. Operation and Maintenance Data: Comply with Section 01782.
  - b. Complete and submit applicable forms from Section 01999.
    - 1) Extended Warranty Form
    - 2) Instrumentation Data and Calibration Test Form
    - 3) Manufacturer's Installation Certification Form
    - 4) Manufacturer's Instruction Certification Form
    - 5) Manufacturer's Representative Service Report
    - 6) Motor Data Form
    - 7) O&M Information Transmittal
    - 8) Proposed Substitution
    - 9) Submittal Transmittal
    - 10) Unit Responsibility Certificate

#### 1.09 QUALITY ASSURANCE

- A. Manufacturer's Experience
  1. A minimum of 15 years of experience in the design, application, and supply of circular clarifiers in wastewater treatment plants.
  2. A minimum of 6 installations in which the proposed mechanism design, including sludge removal system, foam removal system, EDI design, and drive configuration, has been installed and is in operation. Provide installation date, clarifier size and component details, and owner contact information for each installation.
- B. Certificate of Unit Responsibility
  1. Providing a certificate of unit responsibility shall not be construed as relieving the Contractor of overall responsibility for this portion of the Work.
- C. Coordination
  1. The mechanism will be installed by the Contractor during the dry weather season between May and November of 2023.

#### 1.10 DELIVERY, STORAGE AND HANDLING

- A. Fabricate clarifier equipment in the largest sections possible and allowed by shipping carriers. Identify and match components for ease of field erection.
- B. Sequencing Requirements
  1. Clarifier equipment will be installed by the Contractor at a later date.

- C. Site Storage and Handling of Equipment
  - 1. Store the supplied equipment in accordance with the manufacturer's recommendations and instructions.
  - 2. Take responsibility for work, equipment, and materials until inspected, tested and finally accepted.

#### 1.11 MANUFACTURER'S EXTENDED WORKMANSHIP WARRANTY

- A. Provide a written warranty from the manufacturer for the equipment specified in this Section.
  - 1. Warranty Period: Five (5) years from acceptance of equipment.
  - 2. Coverage: Cover defects or failures of materials or workmanship which occur as the result of normal operation and service. The following components are subject to wear and are excluded from coverage:
    - a. Squeegees.
    - b. Skimmer wipers.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Materials, equipment, and accessories specified in this Section shall be the product of the following manufacturer.
  - 1. Clear Stream Environmental

#### 2.02 FABRICATION

- A. Fabricate submerged components of the sludge collector mechanism from Type 304 Stainless Steel.
  - 1. Minimum Thickness of Structural Members: 1/4-inch, or as necessary based on structural design calculations.
- B. Shop Welding
  - 1. Comply with Structural Welding Code, AWS D1.1, of the American Welding Society.
  - 2. For all welded connections, develop the full strength of the connected elements.
  - 3. Seal weld joined or lapped surfaces with minimum 3/16-inch fillet weld. Stitch welding is not permitted.
  - 4. For metals other than stainless steel, grind welds smooth and grind edges of cut or sheared metal to a radius by multiple passes of a power grinder. For stainless steel, dull edges of cut or sheared members by at least 1 pass of a power grinder.

#### 2.03 CLARIFIER EQUIPMENT COMPONENTS

- A. Influent Structure Components
  - 1. Center Column.
  - 2. Energy Dissipating Inlet.

3. Flocculation Well.
  4. Weir Plates and Scum Baffle.
- B. Center Column
1. Description: Stationary, vertical column with bottom support flange for bolting to the clarifier floor slab at the center of the clarifier tank and with a similar support flange at the top for supporting the drive unit, rotating mechanism, and access bridge.
  2. Wall Thickness: As required for structural loads, minimum 1/4-inch thick and designed to withstand twice the continuous torque of the drive mechanism.
  3. Material: Type 304 stainless steel.
  4. Bottom Support Flange:
    - a. Thickness: As required for structural loads, minimum 1-1/4-inch thick.
    - b. Material: Type 304 stainless steel.
    - c. Weld bottom support flange to center column with full penetration welds.
    - d. Bolt Holes: Size, number, and spacing to accommodate required number and size of anchor bolts.
  5. Top Support Flange:
    - a. Thickness: Minimum 3/4-inch thick.
    - b. Material: Type 304 stainless steel.
    - c. Welded to center column with full penetration welds.
    - d. Designed for bolting the drive unit and access bridge to the flange.
  6. Center Column Anchor Bolts:
    - a. See Section 2.07.A in this Specification.
- C. Energy Dissipating Inlet (LA-EDI)
1. Performance Requirements:
    - a. Supported from the center well support structure.
    - b. Function: Enhance flocculation and diffuse influent liquid into clarifier.
    - c. Size and Dimensional Design Details: Provided by US Patent Holder (Licensor) and licensed to Owner (Licensee). Licensing fees shall be paid by the selected manufacturer to Clarifiers, Inc., P.O. Box 745, Enfield, NH 03748 (Licensor) and shall be included in clarifier mechanism cost.
    - d. Equip with multiple wing-type outlet nozzles attached to bottom of influent well. Nozzle ports shall be arranged in an opposing jet configuration to create flow impingement, disperse energy and promote flocculation.
- D. Flocculation Well
1. Locate flocculation well outside of the EDI. Design flocculation well to diffuse the liquid into the clarifier without disturbance or formation of velocity currents.

2. Provide baffled openings near the water surface to allow scum to exit the flocculation well. Equally space openings around the circumference of the flocculation well.
  3. The flocculation well shall be not less than 17'-6" diameter x 4'-6" side depth.
  4. Fabricate flocculation well from 3/16-inch thick Type 304 stainless steel plate with stiffening members located as needed to maintain rigidity with stiffening angles around top edge.
  5. Scum relief ports shall be provided on the flocculation well.
  6. Flocculation well may be stationary or rotating.
    - a. Stationary: Support flocculation well from the bridge framework with additional supporting members as required.
    - b. Rotating: Support from the drive cage or from the rake arms. Design submerged supports extending from the rake arms in a manner that minimizes horizontal flow disruption.
- E. Sludge Removal Components
1. Description
    - a. Function: Transport settled sludge and prevent sludge dilution at the sludge pit.
    - b. Basic Elements: Drive cage and sludge rake arms.
  2. Drive Cage
    - a. Provide a drive cage that encompasses the center column and provides connections for rotating elements of the clarifier equipment.
    - b. Material: Type 304 rolled stainless steel with a minimum thickness of 1/4" meeting AISC specifications when twice the continuous torque of the drive unit is applied.
    - c. Design drive cage to transmit torque from the drive unit to the sludge rake arms and skimmers.
    - d. Bolt top of drive cage to the main gear which operates to rotate the drive cage with the attached rake arms, skimmer arms, and flocculation well.
  3. Sludge Rake Arms
    - 1) General: Provide two sludge rake arms equipped with spiral-shaped sludge scraper blades and adjustable squeegees.
    - a. Sludge Scraper Blades:
      - 1) The clarifier mechanism shall have two rigidly braced 304 stainless steel arms supported by the drive cage. The arms shall be of triangular or rectangular truss connection with rectangular truss dimensions not less than 4'-0" high x 3'-6" wide. The arms shall be connected to the drive cage with adjustable clevis rods.
      - 2) Each arm shall support one (1) 304 stainless steel spiral-shaped scraper blade that is fitted with vertically adjustable squeegees constructed from 20ga Type 304 stainless steel.
      - 3) The scraper blade depth shall vary from a minimum of 8 inches at the tank periphery to a maximum depth of at the opposite end near

the center of the tank. The maximum depth of the flight shall be determined by sludge transport calculations supplied by the manufacturer.

- 4) Designed and constructed to a logarithmic spiral curve with a constant 30 degree angle of attack and be positioned to effectively transport sludge to the sludge pit.

b. Squeegees:

- 1) Material and Thickness: Type 304 stainless steel, 20 gauge minimum thickness.
- 2) Fasten to sludge scraper blade with stainless steel bolts. Provide slotted bolt holes in squeegee to allow vertical adjustment.

- c. Provide a neoprene seal or equivalent at the termination point between the scraper blades and the sludge collection drum or the sludge withdrawal ring.

- d. The collector arms shall be designed to meet AISC specifications when twice the continuous torque of the drive unit is applied as a uniform load to both arms.

F. Scum Removal System

1. Description:

- a. Consisting of a scum skimmer assembly that pushes floating scum to a scum trough for removal. Basic components of skimmer assembly include scum deflector blades and skimmer device.

2. Materials:

- a. Skimmer Support Arms: Structural Steel
- b. Scum Deflector Blades: 1/4" minimum thickness steel plate
- c. Scum Skimmer Wipes: Oil resistant neoprene
- d. Wear Block: Polyvinyl Chloride
- e. Wear Block Spring Enclosure: Welded steel or cast iron housing
- f. Springs, Threaded Fasteners: 18-8 stainless steel
- g. Scum Trough and Scum Beach:
  - 1) Fabricated from 3/8" minimum thickness steel plate.
  - 2) Supported from clarifier wall by structural steel braces.

3. Structural Design:

- a. Space supports brought up from the truss arm at not greater than 10 feet apart.
- b. Attach inner end of skimmer tangentially to flocculating well.
- c. Support the scum trough and scum beach (inclined ramp) from tank wall using structural steel braces.
  - 1) Scum Trough Width, 1'-2" minimum.
- d. 8-inch minimum diameter standard pipe flanged connection for scum discharge pipe.

- e. No internal stiffeners or structural members which obstruct scum flow.
  - 1) Scum beach (inclined ramp):
    - a) Length: 7'-0" minimum along the peripheral scum baffle.
- 4. Mechanical Design:
  - a. Skimming Device: Attach a scum deflector blade to the collector mechanical arm to move floating scum outward to a circumferential scum baffle. The scum deflector blade shall extend from the flocculating well to the hinged scum skimmer.
  - b. Attach a hinged scum skimmer to the deflector blade.
  - c. Provide a maximum angle of approach of skimming device scum deflector blade to the scum in order to drift the scum as readily as possible to circumferential baffle.
  - d. Provide an inclined approach ramp (scum beach) and trough with the beach shaped to contain scum as it moved up the incline to the trough by the scum skimmer.
- 5. Elements:
  - a. Scum Skimmers:
    - 1) Provide scum skimming device on the outer end of the scum deflector blade to trap scum for discharge into scum trough. Scum skimming device shall be the full length of the scum trough.
    - 2) Scum skimmer assembly, supports, and sludge collection rake arm designed to operate with launder cleaning brush mechanism supported by the arm, and to withstand forces imposed by brush mechanism.
    - 3) Maintain continuous contact and proper alignment with scum baffle and inclined scum ramp to positively rake scum to the scum trough twice for each revolution of the mechanism.
    - 4) Use a hinged blade with replaceable scum skimmer wipers on the bottom inner and outer edges to seal the entrapped scum and water when moving up the inclined approach ramp to the scum trough.
      - a) Hinged blade adjustable vertically to control the dewatering of scum as it travels up the inclined ramp to the scum trough.
      - b) Hinged blade adjustable vertically over the length to ensure contact with the scum trough even though the trough may not be level.
      - c) Hinged blade capable of being raised and locked out above the water level or held horizontally against the circumferential baffle when skimming is not required.
    - 5) Equipment manufacturer shall size and locate counterweights to be installed by the Contractor.
    - 6) Do not support scum skimmers from the scum baffle.



- b. Wear Block
  - 1) Provide a replaceable wear block on the outer edge of each scum skimmer device.
  - 2) Wear block constantly forced against circumferential scum baffle to keep baffle clean using a coiled spring arrangement.
    - a) Force between baffle and wear block adjustable between 1 to 5 pounds.
    - b) Coiled springs enclosed to protect them from the weather.
    - c) Spring enclosures: Bronze bushed and grease lubricated for easy movement of hinged blades.
- c. Scum Baffles
  - 1) Plates, baffles, and supports: ASTM A167 and ASTM A276, minimum 1/4-inch thick.
  - 2) Fasteners: ASTM A193/A193M and ASTM A194/A194M, Type 316.

G. Weir Plates

- 1. Plates, baffles, and supports: ASTM A167 and ASTM A276, minimum 1/4-inch thick.
- 2. Fasteners: ASTM A193/A193M and ASTM A194/A194M, Type 316.

H. Dissimilar Metals

- 1. Isolate dissimilar metals or connectors to prevent direct contact and electrical conductivity.
- 2. Use 1/8" thick continuous neoprene gasket to insulate aluminum grating, checker plate, and handrail post bases from access walkway support bridge and other components.
- 3. Use insulating washer and Teflon sleeves at bolted connections

## 2.04 ACCESS BRIDGE AND OPERATING PLATFORM

- A. Materials of Construction: Fabricate access bridge and operating platform from the materials listed in the following table:

Component	Material
Structural Support Members and Miscellaneous Structural Elements	Structural Steel
Walking Surface – Along Bridge	Aluminum grating per Section 05530
Walking Surface – Operating Platform	1/4" aluminum checker plate
Slide Plates at Bridge Anchorage	UHMWPE
Anchor Bolts and Fastening Hardware	Type 316 stainless steel

- B. Minimum Clear Width of Bridge Walkway: 36 inches.

- C. Bridge Support Design
  - 1. Design and fabricate main bridge support members with structural beam sections or welded steel trusses to resist structural loads. Diagonally brace against lateral movement.
  - 2. Support bridge support members from the influent center column at the center of the clarifier and the tank wall at the clarifier outer end.
  - 3. Design anchorage at clarifier outer wall with stainless steel bearing plates, UHMW-PE slide plates, and anchor bolts.
- D. Protect dissimilar metals from galvanic corrosion by means of pressure tapes, coatings or dielectric isolators. Protect aluminum in contact with concrete by a heavy coat of bituminous paint.
- E. Provide aluminum three-rung handrail and kickplate along the access walkway and operating platform as specified in this Section and Section 05520. Handrail shall be mounted on each side, 3'-6" above the walkway surface.
- F. Provide an operating platform around the drive mechanism. Size platform with a minimum clearance of 36 inches around the drive.
- G. Support anti-rotation baffle, utilities and spray system from the bridge and operating platform.

## 2.05 DRIVE MECHANISM

- A. Drive Mechanism Components: Electric gear motor, pinion, torque overload protection system, turntable, worm gear and worm gear reducer or cycloidal/helical/planetary reducer with associated appurtenances.
- B. General
  - 1. The center drive mechanism shall consist of a motor driven primary gear reduction unit, steel roller chain drive (if used), shear pin coupling, intermediate wormgear reduction unit (if used), enclosed final gear reduction unit, and a torque limiting device. The intermediate wormgear reduction unit and the final gear reduction unit shall be the product of the Equipment Manufacturer.
- C. Design Parameters
  - 1. The continuous output torque rating of the spur and pinion gearing shall be based on the smaller of the rating values determined from the above ANSI/AGMA standards and a design life of 20 years. The drive shall be designed and rated to develop the following torque values at an approximate output speed of 0.03 rpm (8 fpm arm tip speed.):

Operating Condition	Foot-Pounds	Notes
Continuous	15,000	At 1.0 Service Factor
Alarm	15,000	100% of Continuous
Motor Cut-Off	18,750	125% of Continuous
Momentary Peak	30,000	200% of Continuous
Shear Pin	-	Less than 200% of Continuous

2. All gearing shall be designed to AGMA standards, and the gearbox manufacturer shall be a Member of the American Gear Manufacturers Association (AGMA). All calculations shall be submitted to the engineer for approval substantiating the continuous output torque rating and design life. Calculations shall include the spur gear, pinion, wormgear set, and all bearings used in the intermediate wormgear reduction unit and the final gear reduction unit.
3. The spur gear and pinion calculations shall clearly specify the values used for the following design parameters for surface durability and bending strength ratings:
  - a. Number of pinions
  - b. Actual Face Width
  - c. Tooth Geometry Factor (I and J Factors)
  - d. Load Distribution Factor
  - e. Aspect Ratio
  - f. Allowable Contact Stress
  - g. Allowable Bending Stress
  - h. Pinion Pitch Diameter
  - i. Tooth Diametrical Pitch
  - j. Hardness Ratio Factor
  - k. Elastic Coefficient
  - l. Life Factor
  - m. Application Factor
  - n. Rim Thickness Factor
  - o. Worm & Wormgear Grade
  - p. Pinion & Gear Quality Number

D. Materials of Construction

1. Fabricate components of the drive mechanism from materials specified in the following table:

Component	Material
Main spur gear	Ductile iron ASTM A536, 80-55-06 Forged steel ASTM A536, 80-55-06
Worm (if used)	Through hardened AISI 41L50 alloy steel or AISI 8620 alloy steel
Worm gear (if used)	ASTM B247, gear bronze alloy casting or ASTM A536 ductile iron or UNS 86300 high strength manganese bronze per ASTM B271
Pinion	AISI 4140, 4150 or 4340
Main bearings	SAE 52100, Rockwell C64
Anchor bolts and other fastening hardware	Type 316 stainless steel

E. Lubrication

1. Gears and bearings shall be entirely oil lubricated. Supply lubricants and dust shields for gears and bearings with the installation of the equipment.
2. Install lubrication fittings in readily accessible locations.
3. Oil Lubrication
  - a. Gear and bearing housing shall be fitted with oil level sight glasses.
  - b. Strip liners shall be provided with the main gear for maintenance.
  - c. Gears and bearings shall have an oil reservoir below the main bearing to collect foreign material and prevent contamination of the main bearings and gears with condensate or other contaminants.

F. Electric Gear Motor

G. Motor: The drive motor shall be 1800 rpm conforming to Section 11060. The motor shall be designed for continuous duty, Class II applications in accordance with AGMA 6019-E. The motor shall be Type 2 as specified in Section 11060.

1. Minimum Continuous Horsepower: not less than 3/4.
2. Electrical Service: 480 volts, 3 Phase, 60 hertz
3. Gear Motor Enclosure: Total Enclosed Fan Cooled (TEFC), in NEMA 7 Enclosure.
4. Service Factor: 1.15.
5. Insulation Rating: NEMA Design B employing Class F insulation.
6. Motor Bearings: Rated for a minimum L-10 life of 100,000 hours.
7. Furnish gear motor with the manufacturer's standard enamel coating.

H. Worm Gear Reducer (if used)

1. Provide a worm assembly with a through hardened and ground alloy steel worm and a centrifugally cast bronze worm gear.
2. Load Capacity and Torque Rating: AGMA 6034.
3. Design: AGMA 6022.
4. Provide a self-contained worm gear assembly, enclosed in a cast iron gear case.
5. Roller chain and sprocket drive assembly shall provide power transmission between the gear motor and a special, single-reduction worm gear reducer.
6. Provide a worm that is integral or keyed to the worm shaft.
7. Service factor of 1.25 minimum applied to input horsepower of speed reducer when center drive unit is operating at Design Running Torque.

I. Cycloidal/Helical/Planetary Reducer (if used)

1. The speed reducing unit shall be directly connected to a motor without the use of chains or v-belts, and shall be keyed to the pinion.
2. The main ring gear of cycloidal drives shall be made of high carbon chromium bearing steel and be fixed to the drive casing.

3. An eccentric bearing on the high speed shaft shall roll cycloidal discs of the same material as the cycloidal drives around the internal circumference of this main ring gear.
4. The lobes of the cycloid disc shall engage successively with pins in the fixed ring gear. The movement of the cycloid discs shall be transmitted by pins to the low speed shaft. Speed reducer efficiency shall be a minimum of 90% per reduction stage.
5. Speed reducer of helical or planetary gearing shall be manufactured to AGMA standards and shall provide at least 95% power transmission efficiency per stage.
6. The reducers shall be fitted with radial and thrust bearings of proper size for all mechanism loads and grease-lubricated. As a safety feature, the speed reducer shall be back drivable to release any stored energy as the result of an over torque condition.
7. Service factor of 1.25 minimum applied to input horsepower of speed reducer when center drive unit is operating at Design Running Torque.

J. Pinion Gear

1. Provide a pinion and shaft, which drive the internal spur gear, that are made as an integral unit or keyed and made from heat treated forged alloy steel and designed in accordance with ANSI/AGMA 2004.
2. Rigidly support the pinion by bearings located above and below the pinion gear.
3. Wall Thickness (Above Keyway): Minimum depth of one tooth.

K. Spur Gear Assembly

1. Provide a spur gear of AGMA Quality 6 or higher.
2. If the spur gear is of a split gear design, provide two halves with precision mating surfaces with self-registering and indexed fits.
3. Provide A36 fabricated steel or ASTM A48 Class 40 cast iron spur gear housing.
4. Provide a felt or neoprene seal and dust shield with each spur gear housing at the lower seal (located between the stationary drive base and main gear) and the upper seal (located between the main gear and stationary drive cover).
5. Provide access to the oil drain and condensate valves from the walkway. Provide the ability to determine the oil level and presence of condensate from the walkway.
6. If grease lubricated, provide grease lubrication from the main gear to pinion gear mesh.
7. Firmly mount the drive assembly to a cast iron turntable base with a minimum wall thickness of 1/2" or a fabricated steel turntable base with a minimum thickness of 3/8".
8. Mount the drive base on the center column and provide with a positive leveling feature.
9. Provide a drive base that is suitable for supporting the entire load of the drive mechanism and access bridge.

10. Provide each assembly with an access opening of not less than 22" in diameter to permit inspection and maintenance of components in the interior of the drive unit housing. Provide cover plate and lifting holes for opening.
11. Minimum service factor of 1.25 based on the continuous operating torque.

L. Turntable

1. The turntable base shall have an annular bearing raceway upon which the rotating assembly rests using ball bearings. It shall have a maximum allowable deflection in accordance with the bearing specifications.
2. The allowable modulus of elasticity for the turntable material shall be a minimum of  $29 \times 10^6$  psi.
3. The turntable base shall be a minimum 1 inch thick to insure adequate structural rigidity to properly support the drive bearing and gear.
4. Provide adequate sealing to prevent moisture from entering the drive.

M. Main Bearing

1. Support the mechanism turntable on a ball bearing assembly that uses bearing balls of minimum 1/4-inch-diameter, Grade 50 AISI E52100 chrome alloy steel bearing balls, hardness 60-64 RC, conforming to ANSI/ABMA/ISO 3290 (R2000).
2. The ball bearing assembly has shall be mounted in an ASTM A48 Class 40 cast iron housing. The housing shall be cast as a single piece to provide a leak proof enclosure. The housing shall be complete with seals, oil level dipstick, oil fill, and valve oil and condensation drains. Or the main ball bearing assembly shall be a precision bearing manufactured from AISI 4140 Alloy Steel with minimum 1" diameter Grade 50 E52100 Chrome Alloy Steel Balls.
3. The upper dust and rain seal between the internal spur gear and the housing shall consist of a labyrinth seal fabricated from AISI 304 stainless steel with stainless steel seal clamps and EPDM rubber time seal. A neoprene dust and rain seal located between the internal spur gear and housing shall also be acceptable.
4. Use bearing balls that run in an oil bath.
  - a. For oil bath lubricated bearings, provide bearings that run on replaceable carbon corrected, high carbon steel liners hardened to 38-46 Rockwell C as specified in ASTM E18 and placed in annular raceways in the gear and turntable base.
  - b. Lubrication of the gear teeth shall be accomplished by means of an oil dam and the meshing action of the pinion and the internal gear teeth that shall force lubricant up the face of the teeth.
5. For drives using strip liner bearings, bearing designs in which bearing wear cannot be measured or which require the disassembly of the bearing or final gear reduction or dewatering of the collector basin to measure bearing wear will not be acceptable.
6. The drives shall be designed so that balls and nylons spacers can be replaced without removing the access walkway.

N. Torque Overload Protection

1. Provide an overload protection device and an overload alarm system for the drive mechanism.

2. Enclose overload device in a stainless steel, watertight housing.
3. Mount switches used in the torque overload protection device in NEMA 250, Type 4X rated, Type 316 rated enclosures.
4. Provide an indicator showing the load on the mechanism that is visible from the access bridge and reads in ft-lbs torque or percent continuous operating torque covering the range of torques specified up to 160% of the continuous operating torque.
5. Provide with three switches:
  - a. One to activate the alarm (activate at 80% of the continuous operating torque).
  - b. One to shut down the unit (activate the cutout switch at 110% of the continuous operating torque).
  - c. One back-up switch to shut down the unit at 140% of the continuous operating torque in the event that the cutout switch is not operational.
    - 1) As an alternative to the back-up switch, a NEMA 4X limit switch may be provided to activate when the shear pin breaks.
  - d. Relay signals from the overload switches to the motor controller in MCC-3, and the Owner's PLC.
  - e. Factory-calibrate all alarm switches.
6. Amperage sensing devices shall not be acceptable for torque overload protection.
7. Any exposed linkages shall be stainless steel.
8. In addition to alarm and cutoff, the drive unit is also protected by a shear pin.

## 2.06 ELECTRICAL COMPONENTS

- A. Furnish and install electrical items required but not specifically called for as furnished by the equipment manufacturer.

## 2.07 ACCESSORIES

- A. Anchor Bolts
  1. The equipment manufacturer shall furnish all Type 316 stainless steel anchor bolts, nuts, washers and gaskets necessary for the equipment furnished.
- B. Spare Parts
  1. Spare parts shall be provided as follows:
    - a. 1 set – all bearings and bearing ring seal rings for drive unit, except the main turntable bearing.
    - b. 1 set – all gaskets for drive unit
    - c. 1 set – spur gear seal and replaceable bearing races
    - d. 1 set – springs used in scum collection assemblies, flexible wipers and seals used in scum collection assemblies, and scum arm blade pivot bearing
    - e. 1 set – any special tools required to assemble, disassemble, or maintain the equipment.

- f. 1 year of lubricant supply

## 2.08 FABRICATION

- A. Shop Assembly and Inspection: Factory assemble the clarifier equipment as far as practical to verify that mating parts can be accurately field assembled. Trial fit mating parts and match-mark for field assembly. Submit certification of shop trial assembly and photographs of assembly before shipment. Notify the Owner, installing Contractor, and Engineer prior to the start of shop assembly to provide an opportunity to witness the shop assembly.
- B. Inspection: Shop inspection shall be performed by a qualified inspector and certified by the manufacturer. The inspection shall be documented and all deficiencies noted, corrected, re-inspected and final completion formally authorized. Final shipment authorization shall be by the manufacturer to ensure completion of all fabrication, assembly, and inspection requirements. Submit inspection records and evidence of inspector qualification as part of the submittals.

## PART 3 - EXECUTION

### 3.01 PREPARATION

- A. Prior to assembly of the drive unit, the castings shall have been sandblasted and thoroughly cleaned to remove any foreign particles in the drive base. After assembly, the drive mechanism shall be solvent cleaned and power wire brushed as needed prior to application of manufacturer's standard primer.

### 3.02 INSTALLATION

- A. Align, connect, and install equipment in accordance with the manufacturer's written instructions.
- B. Use equipment shop drawings, anchorage layout drawings, and anchor bolt layout templates to accurately position anchor bolts.
- C. Place the anchorage in accordance with certified prints supplied by the equipment manufacturer.
- D. Install, position, and level the drive unit prior to grouting the center column in place.
- E. Provide factory-trained personnel to check installation and test initial operation per Paragraph 3.03.
- F. Coordinate the installation of the secondary clarifier components with the effluent weirs and baffles.
- G. Certify installation and initial operation of all components on the appropriate forms included in Section 01999.
  - 1. Manufacturer's Installation Certification
  - 2. Instrumentation Data and Calibration Test Form



### 3.03 MANUFACTURER'S FIELD SERVICES

- A. The equipment manufacturer shall provide the services of a field service representative for a total of two (2) trips for a total of not more than four (4) working days for the purpose of instruction and assisting the contractor and the Owner's personnel in the start-up and proper operations of the equipment.
- B. The equipment manufacturer shall furnish operating and maintenance instruction for the equipment to the contractor.
- C. Corrective Actions: Replace or repair work to eliminate defects, deficiencies and irregularities.
- D. Complete and submit the appropriate forms provided in Section 01999.
  - 1. Manufacturer's Representative Service Report
  - 2. Manufacturer's Instruction Certification
  - 3. O&M Information Transmittal

### 3.04 EQUIPMENT AND SYSTEM TESTING

- A. Conduct testing under the supervision of the equipment manufacturer's service technician prior to beginning operational testing of the equipment.
- B. Corrective Actions: Replace or repair work to eliminate defects, deficiencies and irregularities.
- C. Field Tests
  - 1. Torque Testing
    - a. Statically load test the entire mechanism by individually loading each rake arm with 150 percent of the specified continuous operating torque.
    - b. Verify that the torque overload control device settings for alarm and motor cutout meet the requirements herein.
    - c. Individually anchor each arm and measure the load to demonstrate the ability of the rake arm, drive cage and drive unit to withstand the test loading condition.
    - d. Submit the proposed testing procedures, including sketches and calculations, for approval prior to the testing.
- D. Functional Testing
  - 1. Operate the clarifier mechanism in a dry tank and check that there is no binding, jerky, or unusual motion during the run-in period.
  - 2. Check motor amperage for unusual or higher than normal values.
  - 3. If the unit should fail under dry tank testing, stop testing and correct the problem(s).
  - 4. Successful functional testing is required prior to beginning operational testing.
- E. Coordinate with Section 01825 for any additional testing.

### END OF SECTION

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## **SECTION 15050**

### **PIPING SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Work necessary to furnish, install, and test all piping systems, including exposed piping and buried piping, as shown on the Drawings and as specified herein.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 05501 – Anchor Bolts and Anchoring Devices
  - 3. Section 09900 – Coating Systems
  - 4. Section 15141 – Steel Pipe
  - 5. Section 15162 – Reinforced Concrete Pipe
  - 6. Section 15951 – Testing Gravity Flow Pipelines
  - 7. Section 15996 – Testing Pressure Piping

##### **1.03 SUBMITTALS**

- A. Submittals shall demonstrate full compliance with all aspects of this specification, and shall include, but not be limited to, complete manufacturers' data on pipe material, fittings, and coatings.
- B. Comply with Section 01330 and include the following information:
- C. Shop Fabricated Piping
  - 1. Detailed pipe fabrication drawings showing special fittings and bends, dimensions, coatings, and other pertinent information.
  - 2. Layout drawing showing location of each pipe section and each special length; number or otherwise designate laying sequence on each piece.
  - 3. Pipe Wall Thickness: Identify wall thickness and rational method or standard applied to determine wall thickness for each size of each different service including exposed, submerged, buried, and concrete-encased installations for Contractor-designed piping.
  - 4. Hydraulic Thrust Restraint for Restrained Joints: Details including materials, sizes, assembly ratings, and pipe attachment methods.
  - 5. Thrust Blocks: Concrete quantity, bearing area on pipe and undisturbed soil, and fitting joint locations.
  - 6. Dissimilar Buried Pipe Joints: Joint types and assembly drawings.

7. Anchor Bolt Calculations
  - a. Submit calculations and shop drawings with the pipe support submittal in accordance with Section 05501 for anchorage details.
- D. All calculations shall be prepared and signed by a civil or structural engineer currently registered in the State of California.

#### 1.04 DESIGN REQUIREMENTS

- A. Design piping systems in accordance with the following:
  1. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO Standard Specifications for Highway Bridges, as applicable.
  2. Thrust Restraints:
    - a. Design for 240 psi test pressure.
    - b. Allowable Soil Pressure: 2,000 pounds per square foot.
  3. Anchor bolts for pipe supports shall be designed in accordance with the CBC for Seismic Design Category D and Site Class D. This force shall be considered acting at the center of gravity of the piece under consideration.

#### 1.05 PIPING SYSTEM DESIGN

- A. Design Professional:
  1. Provide professional engineering services (“Design Professional”) for the design and inspection of piping systems work. The Design Professional must have not less than ten years experience in the type of piping support, seismic restraint, and expansion control design work required for this project.
  2. The Design Profession shall be a professional engineer currently licensed to practice in the State of California.
  3. The Design Professional must obtain and maintain professional liability insurance in the amount of \$1,000,000 aggregate, to be in effect for the duration of this project plus one year.
  4. The requirements for the Design Professional shall not be construed as relieving the Contractor of overall responsibility for this portion of the Work.
- B. Piping System Design and Inspection:
  1. The Design Professional shall provide the design, inspection, and certification for piping supports (hangers, guides, anchors, structural attachments, etc.), expansion control and seismic restraints as specified in this Section and referenced Sections.
  2. The work of the Design Professional is complementary to the design elements specified in the Contract Documents and intended to provide complete piping system designs. The Design Professional’s inspection responsibilities also complement inspections by the City. The general division of responsibility for work is shown in paragraph 1.05C:
- C. Piping System Design and Inspection Responsibilities
  1. Comply with the design requirements of this specification.

2. Pipe support and seismic restraint placement is subordinate to the function of anchorage, flexibility, and expansion control provisions. Do not interfere with the function of anchorage, flexibility, and expansion control provisions specified on the drawings.
3. Where pipe anchors are specified, they have been designed for longitudinal seismic loading, in addition to other longitudinal forces associated with expansion control, and pipe thrust for the associated piping that is anchored. Rely on the specified anchors for longitudinal seismic bracing of the pipe in these instances.
4. There may be situations where the City wants to control where certain anchors are located, the level of forces that can be transmitted to structures, the direction that expansion growth is allowed, or requires use of particular piping elements. In such cases these elements will be shown and shall be incorporated into the Design Professional's design. Mandatory anchorage locations identified on the drawings and maximum limitations, if any, for structure loads from the anchor will be as indicated on the drawings, identifying location and force. Where structural load would be exceeded, piping flexibility or expansion joints shall be provided to achieve the maximum loading. If a particular type of support, anchor, seismic restraint or expansion element is detailed on the drawings, then those elements shall be incorporated into the Contractor's design. Piping submittals by the Contractor shall include all elements, including those portions directed by the City, as well as complete piping runs. The structural reaction loads for all fixed supports shall be calculated and shown on the Contractor's layout drawings. The Contractor's Design Professional shall, as part of the submittal process, notify the City if he/she believes any City-shown elements are incompatible with the overall piping system and its function.
5. Include consideration of and provisions for:
  - a. Support and pipe restraint independent of equipment and without equipment supported loads exceeding equipment manufacturer's requirements. Obtain maximum nozzle loads from the equipment manufacturer.
  - b. Dielectric separation, as specified in this section.
6. Include all elements of piping systems required for fabrication and construction in the piping layout submittals. Depict couplings, restraint, anchorage, expansion control measures and other elements of the piping system.
7. Depict fitting angles and vertical and horizontal pipe locations, as determined by Contractor, on piping layout drawings.
8. Do not interfere with maintenance functions and access around equipment, including monorails and hoists.

## **PART 2 - MATERIALS**

### **2.01 GENERAL**

- A. Pipe sizes are nominal inside diameter unless otherwise noted. All sizes of pipe shall be as called out on the Plans and specified herein. All pipe and fittings delivered to the job site shall be clearly marked to identify the material, class, thickness, and manufacturer. All material shall be new and free of blemishes.
- B. Where only one type of pipe is called out, no substitutions shall be allowed.

- C. Piping materials of like kind shall be the product of one manufacturer.
- D. The Contractor is responsible for furnishing and installing all items necessary to make a complete and workable piping system.
  - 1. This includes, but is not limited to, valve boxes, insulating couplings and gaskets, piping specialties, and all other items required by the nature of the installation.
  - 2. Any item not specified herein but required by the installation shall be of first quality, equal in grade to similar materials specified herein, and shall comply with all applicable reference standards listed herein.
- E. Paint all exposed pipe in conformance with requirements of Section 09900.

## 2.02 PIPE IDENTIFICATION SCHEDULE

- A. Piping materials are identified by a “Type” designation in these specifications.
- B. Specific piping materials, testing requirements and other pertinent information is summarized for each pipe type.
- C. Pipelines are designated on the Plans by a two-element code, the first representing the nominal pipe diameter and the second an abbreviation indicating the piping system.
- D. The following schedules, except where indicated otherwise on the Plans, identify pipe type to be used for each piping system.
- E. Where the pipe type is not specifically identified on the Plans, select materials based on the pipe service as listed in the following schedule unless otherwise noted all materials are as specified in subsequent articles of this specification.

Abbr	Service	Pipe Type – Unless Otherwise Indicated
3W	3-Water	Pipe Type B – Polyvinyl Chloride Pipe
AL	Alum	Pipe Type B – Polyvinyl Chloride Pipe
SCI, ML	Secondary Clarifier Influent	Pipe Type A – Steel Pipe Pipe Type C – Reinforced Concrete Pipe
DR	Drain	Pipe Type B – Polyvinyl Chloride Pipe Sewer (PVC-S)
HCS	Hypochlorite Solution	Pipe Type B – Polyvinyl Chloride Pipe
RAS	Return Activated Sludge	Pipe Type A – Steel Pipe Pipe Type C – Reinforced Concrete Pipe

## 2.03 PIPE TYPE A – STEEL PIPE

- A. Comply with Section 15141

## 2.04 PIPE TYPE B – POLYVINYL CHLORIDE PIPE

- A. Polyvinyl Chloride - Pressure (PVC-P)
  - 1. Pipe: Schedule 80 as listed, Class 12454-B, rigid, unplasticized pipe made from polyvinyl chloride in accordance with ASTM D1784 and D1785.
  - 1. Fittings: Schedule 80 to match pipe, of the same material as the pipe, conforming to ASTM D2467.

2. Joints: Joints shall be solvent weld, except that threaded or flanged joints are to be used where required at specific locations
  3. Cement: Solvent weld connections shall be made in strict accordance with the pipe manufacturer's recommendations using a solvent cement and primer (if recommended) meeting ASTM D2564. Solvent cement for Sodium Hypochlorite piping shall be IPS 724 CPVC solvent cement or equal. Primer shall be IPS P-70 primer or equal.
  4. Above ground piping, piping above the normal water surface and piping that will not drain shall be insulated per Specification 15250.
  5. Pipe Cleaner: In accordance with the pipe manufacturer's recommendations.
- B. Polyvinyl Chloride - Sewer (PVC-S)
1. Pipe and fittings
    - a. 4-inch through 15-inch: Polyvinyl chloride sewer pipe and fittings, ASTM D3034, SDR26.
    - b. 18-inch through 48-inch: Polyvinyl chloride large diameter gravity sewer pipe and fittings, ASTM F679.
  2. Joints: Elastomeric gasket, ASTM D3212.
  3. Gaskets: SBR, ASTM F477.
- C. Valves (4" and less):
1. Ball; PVC body, Chemtrol Tru Bloc TU Series, Asahi/America DuoBloc TU Series, GSR TU Series, or equal, with Teflon seats and EPDM O-rings.
  2. Diaphragm; PVC body, Chemtrol Series PD, Posacon 677, or equal, with EPDM of Teflon diaphragm.
  3. Ball check; PVC body, Chemtrol Series BC, Asahi/America, or equal, with EPDM or Teflon seats/seals.
- D. Valves (5" and larger):
1. Diaphragm; ITT Dia-Flo 2558-2-M, Hills-McCanna 0649-1-38, or equal.
  2. Swing or ball check; fully lined valve body; fully coated swing check flapper or ball check ball; lining and coating shall be Hypalon or fluorinated ethylene propylene. Valve and Primer Co. APCO Series 100R, Peabody Dore Model 770, or equal.

## 2.05 PIPE TYPE C – REINFORCED CONCRETE PIPE

- A. Comply with Section 15162

## 2.06 PIPING CONNECTIONS – MISCELLANEOUS

- A. Metallic Flexible Couplings and Flange Adapters
1. Where shown on the Plans or required by installation, flexible couplings and flange adapters shall be furnished and installed by the Contractor.
  2. All couplings shall be restrained and suitable for a minimum working pressure of 150 psi.

3. Flexible couplings for steel pipe and steel pipe sizes shall be Rockwell (Smith-Blair) Type 411, Romac Style 400, or equal with the stop removed from the middle ring unless otherwise shown.
  4. Flexible couplings for cast or ductile iron pipe and equivalent sizes shall be Rockwell (Smith-Blair) Series 411, Dresser Style 38, or equal.
  5. Flexible reducing couplings shall be Rockwell Type 415, Romac Style RC400, or equal.
  6. Sleeves shall be 10 inches minimum length and have a fusion bonded coating suitable for recycled water.
  7. All coupling gaskets shall be synthetic rubber suitable for recycled water.
- B. Dielectric Isolation
1. General
    - a. All metallic piping shall be dielectrically isolated from all other metal piping, hangers, brackets, steel reinforcing and all other metal structures.
    - b. All piping shall be dielectrically isolated from piping or other materials constructed from dissimilar metals.
  2. Flange Insulators
    - a. Flange dielectric insulation sets shall contain full faced gaskets, full length sleeves, and double insulating washers or as specifically indicated on the Plans.
    - b. Insulation material for the flange insulation sets shall be phenolic resin and flange faced gaskets shall be neoprene faced phenolic resin.
    - c. Insulating materials shall be of a type designated by the manufacturer as suitable for use at the operating and test pressures specified for the type of pipe on which the materials are to be installed.
  3. Wall Penetrations
    - a. Penetrations through reinforced concrete walls shall be constructed to prevent metal to metal contact between the pipe and reinforcing steel in the wall.
  4. Insulating Unions
    - a. Insulating unions shall meet Federal Specifications WW-U-532, Class 1 requirements for dimensional, strength, and pressure requirements. Insulation barrier shall limit galvanic current to 1% of the short circuit current in a corresponding metallic joint.
    - b. The insulating material shall be impervious to water. Each connector shall match the type of material to which it connects.
  5. Testing
    - a. Dielectric isolation devices shall be field tested for continuity isolation prior to coating and backfill.



## 2.07 PIPE SUPPORTS

### A. General

1. All piping shall be supported against sag, lateral and vertical movement in a manner which will prevent undue strain on any valve, fitting, pipe or piece of equipment. Piping shall be supported by anchor brackets, guides, saddles, or hangers. Pipe movement due to thermal expansion and internal pressure and dynamic forces shall be accommodated by pipe springing, anchors, expansion joints, and guides selected for the specific purpose by the Design Professional retained under the provisions of paragraph 1.05. The details for the piping support, anchorage, seismic bracing, and expansion control systems shall be submitted with the Contractor's piping layout drawings as product data.
2. Unless otherwise indicated on the Plans, exposed piping shall be supported at the base of all risers, at intervals not to exceed 5 ft on all horizontal runs of pipe 2 in. and smaller, at intervals not to exceed 8 ft on all horizontal runs of pipe 2-1/2 in. through 4 in., and at intervals not to exceed 12 ft. on all horizontal runs of pipe larger than 4 in.
3. In addition, pipe supports shall be provided at changes in direction or elevation, adjacent to flexible couplings, at pipe connections to equipment and where otherwise shown.
4. No attempt has been made to show all required pipe supports in all locations, either on the Plans or in the details.
5. The absence of pipe supports and details on any Plans shall not relieve the Contractor of the responsibility of providing a satisfactory piping support system in conformance with the functional and specific support spacing requirements of these specifications.

### B. Pedestal Supports

1. Pedestal pipe supports shall be adjustable, with stanchion, saddle, and anchoring flange as shown.
2. Non-shrink grout shall be used under the floor flanges to give level bearing, and floor flanges shall be bolted to the floor with two stainless steel bolts cast in the concrete, if possible, or using stainless steel concrete anchors.
3. Manufacturers:
  - a. Anvil
  - b. B-Line
  - c. Or equal

### C. Framing Channel

1. Continuous slot, bolted metal framing channels with all associated fittings and hardware. All strut, fittings and hardware shall be made of AISI Type 304 stainless steel. Framing channel shall be 1-5/8 inches wide in varying heights and welded combinations as required to meet load capacities.
2. Comply with the latest revision of MFMA Standards Publication Number MFMA-3, "Metal Framing Standards Publication".

D. Anchors

1. Piping, raceways, accessories, and appurtenances shall be anchored to resist a lateral seismic force of 60 percent of its operating weight as required by the California Building Code.
2. This force shall be considered acting at the center of gravity of the piece under consideration.
3. Piping with flexible connections and/or expansion joints shall be anchored such that the intended uses of these joints are maintained in the piping system.

2.08 TAPS AND FITTINGS

- A. Provide all taps, fittings, shutoff valves, etc., for instrumentation, flow control valves and other devices installed in pipelines. Provide 3,000 pound welded, threaded half couplings, minimum 1-1/2-inch in diameter.
- B. Use threaded insulating bushings, unions, or couplings, as appropriate, for joining threaded pipes of dissimilar metals and where otherwise indicated.
- C. Threaded insulating connections: Nylon, Teflon, polycarbonate, polyethylene, or other non-conductive materials. Viton for chlorine solution piping.

2.09 PLASTIC TRACER TAPE

- A. Tracer tape shall be colored the same as the background colors, and made of inert plastic material suitable for direct burial.
  1. Tape shall be capable of stretching to twice its original length and shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.
- B. Two messages shall be printed on the tape.
  1. The first message shall read "CAUTION RECYCLED WATER PIPE BURIED BELOW" with bold letters approximately 2" high.
  2. The second message shall read "CALL CITY PUBLIC WORKS DEPARTMENT" with letters approximately 3/4" high. Messages shall be printed at maximum intervals of 2'.
- C. Magnetic Tracer Tape
  1. Polyethylene magnetic tracer tape shall be as manufactured by Allen Systems, W. H. Brady Co., Seton Name Plate Corporation, Marking Services Inc., or equal.
  2. Tape shall be acid and alkali-resistant, 3" wide, 0.005" thick, and have 1,500 psi strength and 140 percent elongation value.
  3. The tape shall be inscribed with the words "CAUTION: PIPE BURIED BELOW" and the name of the piping system.

2.10 PIPE CODING MARKERS

- A. Manufacturers
  1. One of the following or equal:
    - a. Brady Company.

- b. Seton Name Plate Corporation.
  - c. Industrial Safety Supply Corporation.
- B. Comply with ANSI A13.1.
- C. Type
  - 1. Mechanically attached type that is easily removable.
  - 2. Do not use adhesive applied type.
  - 3. Pressure sensitive legends applied to plastic backing which is strapped or otherwise mechanically attached to the pipe.
- D. Legend and Backing
  - 1. Resistant to petroleum-based oils and grease.
  - 2. Meet criteria for humidity, solar radiation, rain, salt, fog and leakage fungus, as specified by MIL STD 810C.
- E. Withstand a continuous operating temperature range of 40°F to 180°F.
- F. Manufactured and applied in one continuous length of plastic. Do not provide individual letter type.
- G. Provide in the following letter heights: For markers bearing the legends on the background colors specified in Section 15050 (PIPESPEC).

Outside pipe diameter, <sup>(a)</sup> inches	Letter height, inches
Less than 1-1/2	1/2
1-1/2 through 3	1 1/8
Greater than 3	2-1/4
<sup>(a)</sup> Outside pipe diameter shall include insulation and jacketing.	

- H. Include uni- and bi-directional arrows in the same sizes as the legend. Provide legends and arrows in white on blue or red backgrounds, and black on other specified backgrounds.
- I. All labels and identification tags shall be installed in accordance with the manufacturer's printed instructions, and shall be neat and uniform in appearance. All such tags or labels shall be readily visible from all normal working locations.
- J. Valve tags shall be permanently attached to the valve or structure by means of 2 stainless steel bolts or screws.
- K. Each pipe shall be identified at intervals of 20 feet, and at least one time in each room. Piping shall also be identified at a point approximately within 2 feet of all turns, valves, and on the upstream side of all distribution fittings or branches. Sections of pipe that are too short to be identified with lettered labels and directional arrows shall be tagged and identified similar to valves. Pipe identification shall consist of 3 elements, i.e., painted color coding, a lettered label, and a directional label.

## 2.11 PRESSURE TAPS AND GAUGES

- A. Unless otherwise specified, pressure gauge scales shall be 0 to 50 psi range, shall be 4.5-inch, 1 percent accuracy, full scale, and suitable for bottom stem mounting.

- B. Gauges shall have a Type 316 stainless steel Bourdon tube. All gages shall have a Type 300 stainless steel case, shatterproof glass, and a 1/2-inch NPT bottom connection.
- C. Gages shall be Ashcroft Duragauge Fig. 1279, Ametek 1981L, or equal. Supply with 1/2-inch brass gauge cock. Gage cocks shall be Robertshaw 1303, Ashcroft 1095, or equal.
- D. Protect the exposed threads of each gauge cock by a brass plug or snubber. Orifices shall not be utilized.

## 2.12 ROTAMETERS

- A. Unless otherwise specified, rotameters shall be Brooks Sho-Rate “50,” Wallace & Tiernan 3-inch purge meter, Schute & Koerting, or equal, with integral needle valve and flow controller. Meter tubes shall be glass, floats shall be stainless steel, and cases shall be aluminum or stainless steel. Unless otherwise specified, meter sizes shall be selected so that the flow rate recommended by the manufacturer or the purged equipment falls within the middle third of the meter scale. Units shall have 3-inch minimum scale direct reading in the unit of flow.

## 2.13 STRAINERS

- A. Strainers shall be of Y-pattern and threaded, unless otherwise specified. Body, cover, and plug shall be ASTM A351 CF8M (316) stainless steel. Strainers shall have Type 304 stainless steel screens and tapped and plugged blowoff connections. 2-inch and smaller screen perforations shall be 20 mesh. 2-1/2-inch and 3-inch screen perforations shall be 0.045 inch.

# PART 3 - EXECUTION

## 3.01 PREPARATION AND HANDLING OF PIPE

- A. Each pipe and fitting shall be carefully inspected before the exposed pipe or fitting is installed or the buried pipe or fitting is lowered into the trench.

## 3.02 INSTALLATION OF PIPING

- A. General
  - 1. All pipe shall be carefully placed and supported at the proper lines and grades and, where possible, shall be sloped to permit complete drainage.
  - 2. Piping runs shown on the Plans shall be followed as closely as possible, except for minor adjustments to avoid architectural and structural features. If major relocations are required, they shall be approved by the Construction Manager.
  - 3. Wherever a pipe three inches in diameter and larger passes from concrete to earth, a flexible pipe coupling, shall be installed within 1 foot of the concrete.
  - 4. Ensure full support of the pipe in the earth between and beyond the joints.
  - 5. When installing buried PVC pipe, it shall be “snaked” in the trench. In addition, PVC pipe shall not be laid when temperature is 32°F, or below.
  - 6. Piping shall be installed without springing or forcing the pipe in a manner which would set up stresses in the pipe, valves, or connected equipment.

B. Exposed Pipe

1. Exposed pipe shall mean any pipe not buried or encased in concrete. In erecting exposed pipe, a sufficient number of unions, flanged or grooved end type joints shall be used to allow any section or run of pipe to be disconnected without taking down adjacent runs.
2. All unrestrained joints in pressure pipelines, including bell and spigot, flexible couplings, expansion joints and flange adapters shall have tension bars (tie rods) provided in accordance with AWWA M11 Design Manual, Figures 19.15 and 19.16, and Tables 19.7 and 19.8. Thrust protection shall be for 1-1/2 times the specified test pressure for the pipe.

C. HDPE Pipe Installation (Not Used)

D. Corrosion Protection

1. All buried metal parts such as valves and bolt-ups not cement mortar coated shall be coated with two coats of bitumastic in accordance with Section 09900, and encased with one sheet of 8-mil minimum thickness polyethylene to form a continuous and all-encompassing layer of polyethylene between the protected metal and surrounding earth.
2. All polyethylene shall be secured in place with 10-mil polyethylene tape.

E. Dielectric Connections

1. Where pipes of dissimilar metals are connected, a dielectric insulator shall be provided.
2. Dielectric insulators shall be installed on the first exposed flanges or couplings of pipes which are connected to buried piping.
  - a. For this purpose, an insulating joint or connection shall be provided on exposed existing and new piping which requires cathodic protection, within ten feet of each point of burial.
  - b. Where connections are made between existing ferrous metal piping and new piping which is to receive cathodic protection, a dielectric insulator shall be installed.
3. Insulating flange gasket sets shall be installed at the specified locations.
  - a. All insulating components shall be cleaned of all dirt, grease, oil and other foreign materials immediately prior to assembly.
  - b. Bolt holes in mating flanges shall be properly aligned at the time bolts and insulating sleeves are inserted to prevent damage to the insulation.
  - c. After flanged bolts have been tightened, each insulating washer shall be inspected for cracks or other damage.
  - d. All damaged washers shall be replaced. After assembly, resistance between each bolt and flange shall be measured with an approved ohmmeter, and the minimum resistance shall be 50,000 ohms.

F. Locating Wire

1. All runs of non-metallic pipe shall have a No. 10 gauge solid soft drawn copper wire laid along the top of pipe to facilitate locating the pipe at a later date.
2. The wire shall be stubbed up inside each valve box.

3. Continuity test shall be conducted on each splice at all locations.

### 3.03 PIPELINE CLEANING

#### A. Cleaning

1. The interior of all pipelines shall be thoroughly cleaned of all debris prior to testing and prior to connection of pipe to equipment, control and regulating devices or instrumentation.
2. Cleaning shall be accomplished by flushing with water at a velocity of 2.5 ft/s or by pulling a tightly fitting cleaning ball or swab through the pipe.
3. Accumulated debris shall be removed by dropping spools or valves.
4. No test shall commence until the pipeline is completely cleaned to the satisfaction of the Construction Manager.
5. Pump suction lines shall be cleaned prior to operation of pumps.

#### B. Disinfection (Not Used)

### 3.04 FIELD TESTING

#### A. General

1. All piping shall be subject to acceptance tests as specified in Section 15951 and Section 15996.
2. The Contractor shall provide all necessary utilities, labor, and facilities for testing, and shall dispose of all waste, including water.
3. All tests shall be conducted in the presence of the Construction Manager.

#### B. Pressure Pipelines: All pressure pipelines installed in this project shall be subject to field and acceptance tests as specified in Section 15996.

#### C. Gravity Pipelines: All gravity pipelines installed in this project shall be subject to field and acceptance tests as specified in Section 15951.

### **END OF SECTION**

## **SECTION 15060**

### **PIPE HANGERS AND SUPPORTS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Hangers and supports for all piping systems specified in Sections 15050.
- B. This section does not include pipe supports for fire sprinkler systems, pipe anchors, guides or seismic restraints.
- C. For seismic restraint requirements for piping, see Section 15097.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this section
  - 1. Section 01330 – Submittals
  - 2. Section 01610 – Seismic Anchorage and Bracing
  - 3. Section 05501 – Anchor Bolts and Anchoring Devices
  - 4. Section 15050 – Piping Systems
  - 5. Section 15097 – Seismic Restraints for Piping
  - 6. Section 15250 – Insulation for Exposed Piping and Equipment

##### **1.03 QUALITY CONTROL**

- A. Operating Conditions
  - 1. The hangers and supports specified in this section are provided to resist pipe loads occurring primarily in the downward (gravity) direction. For the purpose of pipe hanger and support selection, this section establishes pipe support classifications based on the operating temperatures of the piping contents. Pipe support classifications are as follows:
    - a. Hot Systems: A. 120°F to 450°F.
    - b. Ambient Systems: B. 60°F to 119°F.
    - c. Cold Systems: C-1. 33°F to 59° F, C-2. -20°F to 32°F.
- B. Hanger and Support Selection
  - 1. Select pipe hangers and supports as specified. Base selections upon the pipe support classifications specified in this section, the piping insulation thickness specified in Section 15250, and any special requirements which may be specified in the contract documents.
  - 2. Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the type of support to be used at each hanger point.

3. Design and select hangers and supports to withstand all static and specified dynamic conditions of loading to which the piping and associated equipment may be subjected. As a minimum, consider the following conditions:
  - a. Weights of pipe, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.
  - b. Weight of hydrostatic test fluid or cleaning fluid if normal operating fluid contents are lighter.
  - c. Reaction forces due to the operation of safety or relief valves.
  - d. Wind, snow, or ice loadings on outdoor piping.
4. Size hangers and supports to fit the outside diameter of pipe, tubing, or, where specified, the outside diameter of insulation.
5. Where negligible movement occurs at hanger locations, use rod hangers for suspended lines, wherever practical. For piping supported from below, use bases, brackets or structural cross members.
6. For the suspension of size 2-1/2" and larger pipe and tubing, use hangers capable of vertical hanger component adjustment under load.
7. Provide supporting systems which provide for and control the free or intended movement of the piping including its movement in relation to that of connected equipment.
8. Where there is horizontal movement at a suspended hanger location, select hanger components to allow for swing. Do not permit the vertical angle of the hanger rod to exceed 4° at any time.
9. Do not permit contact between a pipe and hanger or support component, constructed of dissimilar metals. Prevent contact between dissimilar metals when supporting copper tubing by using copper-plated, rubber, plastic or vinyl coated, or stainless steel hanger and support components.
10. Unless otherwise specified, existing pipes and supports shall not be used to support new piping.
11. Unless otherwise specified, pipe support components shall not be attached to pressure vessels.
12. Stock hanger and support components shall be used wherever practical.

#### 1.04 INDUSTRY STANDARDS

- A. This section contains references to the following documents. They are a part of this section as specified and modified. In case of conflict between this section and the listed documents, the requirements of this section shall prevail.
- B. Unless otherwise specified, references to documents shall mean the documents in effect at the time of Advertisement for Bids or Invitation to Bid (or on the effective date of the Agreement if there were no Bids).
- C. If referenced documents have been discontinued by the issuing organization, references to those documents shall mean the replacement documents issued or otherwise identified by the organization or, if there are no replacement documents, the last version of the document before it was discontinued.



- D. Where document dates are given in the following listing, reference to those documents shall mean the specific document version associated with that date, whether or not the document has been superseded by a version with a later date, discontinued, or replaced.

Reference	Title
AISC Manual of Steel Construction	American Institute of Steel Construction, Manual of Steel Construction, - 13th Edition
CBC	California Building Code
FEDSPEC WW-H-171e	Hangers and Supports, Pipe
MFMA-4	Metal Framing Manufacturer's Association, Metal Framing Standards Publication
MSS SP-58	Manufacturers Standardization Society Pipe Hangers and Supports—Materials, Design and Manufacture
MSS SP-69	Manufacturers Standardization Society Pipe Hangers and Supports—Selection and Application

#### 1.05 SUBMITTALS

- A. Provide hanger and support locations, load calculations, and manufacturer layout and detail drawings as part of the submittals for equipment and piping coordination and installation drawings required in Section 15050.
- B. The load and support design calculations shall be stamped and signed by a licensed Civil or Structural Engineer in the State of California. Comply with Sections 01610 and 05501. Coordinate calculations with those required by Section 15097.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. B-Line
- B. Carpenter & Paterson
- C. Kin-Line
- D. Anvil International
- E. Michigan
- F. Pipe Shields Incorporated
- G. Superstrut
- H. Unistrut
- I. Or equal as specified in Section 01330
- J. Comply with MSS SP-69 and FEDSPEC WW-H-171e for pipe support components and MFMA-4 for framing systems

#### 2.02 PRODUCTS

- A. Material
1. Pipe hangers and supports, structural attachments, rack and trapeze supports, fittings and accessories: 316 stainless steel.

2. Nuts, bolts, washers, and other fasteners: Type 316 stainless steel.
3. Safety end caps on all framing channel.
4. Comply with MSS SP-58 for supports and MFMA-4 for framing systems.

B. Pipe Hangers and Supports

1. Type 1 – Clevis Pipe Hanger, configuration and components equivalent to MSS and FEDSPEC Type 1.
  - a. Steel pipe (insulated): B-Line B3100, Anvil International 260, or equal, with insulation shield.
  - b. Steel pipe (uninsulated): B-Line B3100, Anvil International 260, or equal.
  - c. Cast and ductile iron pipe: B-Line B3102, Anvil International 590, or equal.
  - d. Copper pipe (uninsulated): B-Line B3104 CT, Anvil International CT-65, or equal.
  - e. Copper pipe (insulated): B-Line B3100, Anvil International 260, or equal, with insulation shield.
  - f. Plastic pipe: B-Line B3100 C, Carpenter & Paterson Fig. 100PVC, or equal.
2. Type 2 – J Pipe Hanger, configuration and components equivalent to MSS Type 5
  - a. Steel pipe: B-Line B3690, Anvil International 67, Michigan model 418, or equal.
  - b. Copper and plastic pipe: Michigan model 419, Unistrut J 1205N series, or equal.
3. Type 3 – Double Bolt Pipe Clamp, configuration and components equivalent to MSS and FEDSPEC Type 3.
  - a. Steel pipe (insulated): B-Line B3144, Anvil International 295, or equal, with insulation shield. Insulation shield is optional for hot and ambient systems.
  - b. Steel pipe (uninsulated): B-Line B3144, Anvil International 295, or equal.
  - c. Copper pipe (insulated only): B-Line B3144, Anvil International 295, or equal, with insulation shield.
4. Type 4 – Adjustable Roller Hanger, configuration and components equivalent to MSS Type 43 and FEDSPEC Type 44.
  - a. Steel pipe (insulated): B-Line B3110, Anvil International 181, or equal, with insulation shield.
  - b. Steel pipe (uninsulated): B-Line B3110, Anvil International 181, or equal.
  - c. Copper pipe (insulated only): B-Line B3110, Anvil International 181, or equal, with insulation shield.
  - d. Plastic pipe: B-Line B3110, Anvil International 181, or equal.
5. Type 5 – Single Pipe Roll, configuration and components shall be equivalent to MSS Type 41 and FEDSPEC Type 42.
  - a. Steel pipe (insulated): B-Line B3114, Anvil International 171, or equal, with insulation shield.
  - b. Steel pipe (uninsulated): B-Line B3114, Anvil International 171, or equal.

- c. Plastic pipe: B-Line B3114, Anvil International 171, or equal.
- 6. Type 6 – Framing Channel Pipe Clamp
  - a. Steel pipe (uninsulated):
    - 1) Pipe size 3/8” and 1/2”: 16-gage;
    - 2) 3/4” through 1 1/4”: 14 gage;
    - 3) 1-1/2” through 3”: 12-gage;
    - 4) 3 1/2” through 5”: 11- gage;
    - 5) 6 and 8”: 10-gage;
  - b. Michigan Model 431, Powerstrut PS 1100, Unistrut P 1109 series, or equal.
  - c. Steel pipe (insulated): Pipe clamp as described in Paragraph 2.02 B.6.a with insulation shield.
  - d. Copper (uninsulated) and plastic pipe:
    - 1) Pipe size 3/8” and 1”: 16-gage;
    - 2) 1-1/4” and 1-1/2”: 14-gage;
    - 3) 2” through 3”: 12-gage;
    - 4) 4”: 11-gage;
    - 5) Clamp: copper-plated, plastic coated or lined with dielectric material;
    - 6) Michigan model 432, Powerstrut PS 1200, Unistrut P 2024C and P 2024PC series, or equal.
  - e. Copper pipe (insulated): Pipe clamp shall be as described in Paragraph 2.02 B.6.a with insulation shield.
- 7. Type 7 – U-Bolt Configuration equivalent to MSS and FEDSPEC Type 24.
  - a. Steel pipe (uninsulated): Anvil International. 137, B-Line B3188, or equal.
  - b. Steel pipe (insulated): Anvil International. 137, B-Line B3188, or equal, with insulation shield.
  - c. Cast and ductile iron pipe: Anvil International. 137, B-Line B3188, or equal.
  - d. Copper pipe (uninsulated): Carpenter & Paterson Fig. 222 CT, B-Line B3501 CT, Anvil International. 137C, or equal.
  - e. Copper pipe (insulated): Anvil International. 137, B-Line B3188, or equal, with insulation shield.
  - f. Plastic pipe: Anvil International. 137C, Michigan model 151, B-Line B3188 C, or equal.
- 8. Type 8 – Adjustable Pipe Roll Support
  - a. Steel pipe (insulated): B-Line B3122, Anvil International. 177, or equal, with insulation shield.
  - b. Steel pipe (uninsulated): B-Line B3122, Anvil International. 177, or equal.
  - c. Copper pipe (insulated only): B-Line B3122, Anvil International. 177, or equal, with insulation shield.
  - d. Plastic pipe: B-Line B3122, Anvil International. 177, or equal.

9. Type 9 – Welded Pipe Stanchion
  - a. Minimum material thickness: standard schedule pipe, cut to match contour of the pipe elbow.
  - b. Limit use of this support to ambient systems only.
10. Type 10 – Pipe Stanchion Saddle and Yoke, comply with MSS Type 37 and FEDSPEC Type 38.
  - a. Steel pipe (insulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal, with insulation shield.
  - b. Steel pipe (uninsulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal.
  - c. Cast and ductile iron pipe: Carpenter & Paterson Fig. 125, B-Line B3090 NS, or equal.
  - d. Copper pipe (uninsulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal, with insulation shield or lined with dielectric material.
  - e. Copper pipe (insulated): Carpenter & Paterson Fig. 125, B-Line B3090, or equal, with insulation shield.
  - f. Plastic pipe: Carpenter & Paterson Fig. 125, B-Line B3090, or equal.
11. Type 11 – Offset Pipe Clamp, Provided with configuration and components specified using standard designs offered by a pipe hanger component manufacturer.
  - a. Steel pipe (insulated): B-Line B3148, Anvil International 103, or equal, with insulation shield.
  - b. Steel pipe (uninsulated): B-Line B3148, Anvil International 103, or equal.
  - c. Cast and ductile iron pipe: B-Line B3148 NS, Anvil International 103, or equal.
  - d. Copper pipe (insulated): B-Line B3148, Anvil International. 103, or equal, with insulation shield.
  - e. Copper pipe (uninsulated): B-Line B3148, Anvil International. 103, or equal, lined with dielectric material.
  - f. Plastic pipe: B-Line B3148, Anvil International. 103, or equal.
  - g. Vertical pipe support applications: as specified above except do not use insulation shields for insulated pipe.
12. Type 12 – Riser Clamp, configuration and components equivalent to MSS and FEDSPEC Type 8.
  - a. Steel pipe (insulated): B-Line B3373, Anvil International 261, or equal.
  - b. Steel pipe (uninsulated): B-Line B3373, Anvil International 261, or equal.
  - c. Cast and ductile iron pipe: B-Line B3373, Anvil International 261, or equal.
  - d. Copper pipe (insulated): B-Line B3373 CT, Anvil International CT-121, Michigan model 511, or equal.
  - e. Copper pipe (uninsulated): B-Line B3373 CT, Anvil International CT-121, Michigan model 511, or equal.
  - f. Plastic pipe: B-Line B3373, Anvil International. 261c, or equal.

13. Type 13 – Framing Channel Pipe Strap, configuration equivalent to MSS Type 26.
  - a. Steel pipe (uninsulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.
  - b. Steel pipe (insulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.
  - c. Copper pipe (uninsulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield or lined with dielectric material.
  - d. Copper pipe (insulated): Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal, with insulation shield.
  - e. Plastic pipe: Superstrut No. C-708-U, Powerstrut PS 3126, Kin-Line No. 477, or equal.
- C. Rack and Trapeze Supports
  1. General
    - a. Unless otherwise specified, provide trapeze and pipe rack components minimum thickness of 12 gage, with a maximum deflection 1/240 of the span.
  2. Type 20 – Trapeze Pipe Support
    - a. For trapeze pipe support cross members, use framing channel as specified in Paragraph 2.02 E.5. For flat plate fittings, 1-5/8" square standard design manufactured by framing channel manufacturer, Unistrut P2471, B-Line B202-2, or equal.
  3. Type 21 – Pipe Rack Support
    - a. For post and cross members, use framing channel as specified in Paragraph 2.02 E.5. For pipe rack fittings, use standard design manufactured by framing channel manufacturer. For 90° fittings, use gusseted Unistrut P2484, B-Line B844, or equal. Provide post base fittings as specified in Paragraph 2.02 D.5.
- D. Structural Attachments
  1. Type A –Insert For Concrete:
    - a. Concrete inserts: Comply with MSS and FEDSPEC Type 18.
    - b. Anvil International 282, Carpenter & Paterson Fig. 108, or equal.
  2. Type B – Side Beam Bracket
    - a. Comply with MSS Type 34 and FEDSPEC Type 35.
    - b. Anvil International. 202, B-Line B3062, or equal.
  3. Type C –Beam Clamp with Extension Piece
    - a. Comply with MSS and FEDSPEC Type 30.
    - b. Anvil International. 218 with Fig. 157 extension piece, B-Line B3054, or equal.
  4. Type D – Beam Clamp with Eye Nut
    - a. Beam clamp and eye nut: forged stainless steel.

- b. For configuration and components, comply with MSS and FEDSPEC Type 28.
    - c. Anvil International. 292, Carpenter & Paterson Fig. 297, or equal.
  - 5. Type E – Framing Channel Post Base
    - a. Standard design offered by framing channel manufacturer.
    - b. Single channel: Unistrut P2072A, B-Line B280, or equal.
    - c. Double channel: Unistrut P2073A, B-Line B281, or equal.
  - 6. Type F – Welded Beam Attachment
    - a. Comply with MSS and FEDSPEC Type 22. B-Line B3083, Anvil International. 66, or equal.
  - 7. Type G – Welded Steel Bracket
    - a. Comply with MSS Type 32 and FEDSPEC Type 33 for medium welded bracket.
    - b. Comply with MSS Type 33 and FEDSPEC Type 34 for heavy welded bracket.
  - 8. Type H –Bracket
    - a. Carpenter & Paterson Fig. 340, or equal.
  - 9. Type J – Adjustable Beam Attachment
    - a. Carpenter & Paterson Fig. 151, B-Line B3082, or equal.
  - 10. Type K – Double Channel Bracket
    - a. Wall channel: single channel framing channel as specified in Paragraph 2.02 E.5.
    - b. Cantilever bracket: double framing channel assembly, Unistrut P2542 through P2546, B-Line B297-12 through B297-36, or equal.
  - 11. Type L – Single Channel Bracket
    - a. Wall channel: single channel framing channel as specified in Paragraph 2.02 E.5.
    - b. Cantilever bracket: a single framing channel assembly, Unistrut P2231 through P2234, B-Line B198-6, B198-12, B196-18 and B196-24, or equal.
  - 12. Type M – Wall Mounted Channel
    - a. Wall channel: single channel framing channel as specified in Paragraph 2.02 E.5.
  - 13. Type N – Pipe Stanchion Floor Attachment
    - a. Base plate: 1/2” minimum thickness.
    - b. Make anchor bolt holes 1/16” larger than the anchor bolt diameter.
    - c. Fill space between the base plate and the floor with nonshrink grout.
- E. Accessories
  - 1. Hanger Rods
    - a. Rods: threaded on both ends or continuous threaded and sized as specified.

2. Weldless Eye Nut
  - a. Eye nut: forged stainless steel and complying with MSS and FEDSPEC Type 17.
  - b. Manufacturer: Anvil International. 290, B-Line B3200, or equal.
3. Welded Eye Rod
  - a. Weld-eye rod closed. Make inside diameter of eye a bolt diameter 1/8" larger than the rod diameter.
  - b. Manufacturer: Anvil International. 278, B-Line B3211, or equal.
4. Turnbuckle
  - a. Turnbuckle: forged stainless steel and complying with MSS and FEDSPEC Type 13.
  - b. Manufacturer: Anvil International. 230, B-Line B3202, or equal.
5. Framing Channel
  - a. Framing channel: 1-5/8" square, roll formed, 12-gage.
  - b. Provide channel with a continuous slot along one side with in-turned clamping ridges.
  - c. Single channel: Unistrut P1000, B-Line B22, or equal.
  - d. Double channel: Unistrut P1001, B-Line B22A, or equal.
  - e. Triple channel: Unistrut P1004A, B-Line B22X, or equal.

## 2.03 THERMAL PIPE HANGER SHIELD

- A. Provide thermal shields at hanger, support, and guide locations on pipe requiring insulation.
- B. The shield shall consist of an insulation layer encircling the entire circumference of the pipe and a steel jacket encircling the insulation layer.
- C. Make the thermal shield the same thickness as the piping system insulation specified in Section 15250.
- D. Use the standard shield for hot systems and the vapor barrier shield for cold systems.
- E. Use stainless steel band clamps where specified to ensure against slippage between the pipe wall and the thermal shield.
- F. Standard Shield
  1. Insulation
    - a. Hydrous calcium silicate, high density, waterproof.
    - b. Compressive strength: 100 psi average.
    - c. Flexural strength: 75 psi average.
    - d. K factor: 0.38 at 100°F mean.
    - e. Temperature range: 20°F to 500°F.
  2. Steel Jacket
    - a. Stainless steel. Manufacturer's standard gauge supplied for the given pipe size.

3. Connection
  - a. Butt connect to pipe insulation. Install with steel jacket and insulation flush with end.
- G. Vapor Barrier Shield:
  1. Insulation
    - a. Hydrous calcium silicate, high density, waterproof.
    - b. Compressive strength: 100 psi average.
    - c. Flexural strength: 75 psi average.
    - d. K factor: 0.38 at 100°F mean.
    - e. Temperature range: 20°F to 500°F.
  2. Steel Jacket
    - a. Stainless steel. Manufacturer's standard gauge supplied for the given pipe size.
  3. Connection
    - a. Butt connect shield to pipe insulation.
    - b. Extend insulation 1" each side of steel jacket for vaportight connection to pipe insulation vapor barrier.

## **PART 3 - EXECUTION**

### **3.01 HANGER AND SUPPORT LOCATIONS**

- A. Locate hangers and supports as near as possible to concentrated loads such as valves, flanges, etc.
- B. Locate hangers, supports and accessories within the maximum span lengths specified in the contract documents to support continuous pipeline runs unaffected by concentrated loads. Indicate hanger and support locations and components on the piping layout drawings required by Paragraph 1.05. For pipe support submittals, provide a complete cross reference of each support by mark number, including the page number on which each mark number can be found. Set up the cross reference to permit review from the mark numbers to the drawings, not the other way around.
- C. Locate at least one hanger or support within 2' from a pipe change in direction.
- D. Locate hangers and supports to ensure that connections to equipment, tanks, etc., are substantially free from loads transmitted by the piping.
- E. Where piping is connected to equipment, a valve, piping assembly, etc., that will require removal for maintenance, support piping so temporary supports are not necessary.
- F. Locate pipe supports to prevent "pockets" from forming in pipe between supports due to excessive deflection under load from weight of pipe, medium in the pipe, insulation, valves and fittings.

### **3.02 INSTALLATION**

- A. Construct welded and bolted attachments to the building structural steel which comply with the AISC Manual of Steel Construction. Unless otherwise specified, do not drill or burn holes in the building structural steel.



- B. Do not use hanger components for purposes other than for which they were designed. Do not use components for rigging and erection purposes.
- C. Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.
- D. Use embedded anchor bolts that satisfy the 2010 CBC provisions instead of concrete inserts for supports in areas below water surface or normally subject to submergence.
- E. Install thermal pipe hanger shields on insulated piping at required locations during hanger and support installation. Make butt joint connections to pipe insulation at the time of insulation installation per manufacturer's recommendations.
- F. When hanger and support components are in contact with plastic pipe, make sure the components are free of burrs and sharp edges.
- G. Ensure rollers roll freely without binding.
- H. Roughen finished floor to a ¼ inch amplitude beneath structural attachments and framing channel post bases prior to grouting. Place grout, free of voids and foreign material, between base plate and floor.
- I. Cut and drill base plates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.
- J. Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 7' above the floor.

### 3.03 ADJUSTMENTS

- A. Adjust hangers and supports to obtain required pipe slope and elevation.
- B. Use shims made of material that is compatible with the piping material.
- C. Adjust stanchions prior to grouting their base plates.

### **END OF SECTION**

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## **SECTION 15097**

### **SEISMIC RESTRAINTS FOR PIPING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Seismic restraints for bracing all piping systems specified in Section 15050.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittal Procedures
  - 2. Section 01610 – Seismic Anchorage and Bracing
  - 3. Section 05501 – Anchor Bolts and Anchoring Devices
  - 4. Section 15050 – Piping Systems

##### **1.03 DEFINITIONS**

- A. Longitudinal Direction: Direction parallel to the pipe axis.
- B. Lateral Direction: Direction perpendicular to the pipe axis.

##### **1.04 OPERATING CONDITIONS**

- A. Provide seismic restraints, specified in this section, to resist pipe movements and loads occurring as a result of an earthquake or other seismic event.
- B. Unless otherwise specified, brace all piping to resist seismic loading caused by forces applied at the individual pipe's center of gravity. For seismic loading see Section 01610.

##### **1.05 RESTRAINT SELECTION**

- A. Unless otherwise specified, select, locate and provide seismic restraints for piping in accordance with the contract documents.
- B. Review the piping layout in relation to the surrounding structure and adjacent piping and equipment before selecting the restraint to be used at each point.
- C. Seismic restraints may be omitted from the following installations:
  - 1. Gas piping less than 1" inside diameter.
  - 2. Piping in boiler and mechanical rooms less than 1-1/4" inside diameter.
  - 3. All other piping less than 2-1/2" inside diameter.
  - 4. All piping suspended by individual hangers 12" or less in length from the top of the pipe to the bottom of the support for the hanger.
- D. Do not brace piping systems to dissimilar parts of a building or to dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.

- E. Size restraints to fit the outside diameter of the pipe, tubing, or, where specified, the outside diameter of insulation.
- F. Do not permit contact between a pipe and restraint component of dissimilar metals. Prevent contact between dissimilar metals when restraining copper tubing by the use of copper-plated, rubber, plastic or vinyl coated, or stainless steel restraint components.
- G. Do not use branch lines to brace main lines.
- H. Do not permit seismic bracing to limit the expansion and contraction of the piping system.

#### 1.06 SUBMITTALS

- A. Provide seismic restraint locations, load calculations, and manufacturer's drawings as specified in Paragraph 3.01 as part of the submittals for equipment and piping coordination and installation drawings required in Section 15050.
- B. Provide seismic restraint load calculations for each seismically restrained pipe system prepared and signed by a civil or structural engineer currently registered in the State of California. See Section 01610 for seismic loading required.

### **PART 2 - MANUFACTURERS**

#### 2.01 MANUFACTURERS

- A. Carpenter & Patterson.
- B. B-Line.
- C. Kin-Line.
- D. Anvil International.
- E. Michigan.
- F. Pipe Shields Incorporated.
- G. Superstrut.
- H. Unistrut.
- I. Or equal as specified in Section 01330.

#### 2.02 PRODUCTS

- A. Materials
  - 1. Restraints, including braces and fittings, pipe and structural attachments, trapeze restraints, and accessories: Type 316 stainless steel.
  - 2. Nuts, bolts and washers, fittings and accessories: Type 316 stainless steel.
  - 3. Comply with MSS SP-58
- B. Pipe Attachments
  - 1. Type 1s - Clevis Restraint Attachment
    - a. Provide Type 1, clevis pipe hanger, as specified in Section 15060, 2.02.B.

2. Type 3s - Double Bolt Restraint Clamp:
    - a. Provide Type 3, double bolt pipe clamp, as specified in Section 15060, 2.02.B.
  3. Type 4s - Roller Restraint Attachment
    - a. Provide Type 4, adjustable roller hanger, as specified in Section 15060, 2.02.B.
    - b. Size hold down strap as follows:
      - 1) 1" through 2" Pipe: 1" by 1/8" thick
      - 2) 2-1/2" through 4" Pipe: 1-1/4" by 3/16" thick
      - 3) 6" Pipe: 2" by 3/16" thick
      - 4) 8" Pipe: 2-1/2" by 3/16" thick
      - 5) 10" through 16" Pipe: 2-1/2" by 1/4" thick
      - 6) 20" Pipe: 3" by 1/4" thick
      - 7) 24" Pipe: 3" by 3/8" thick.
  4. Type 7s - U-Bolt Restraint
    - a. Provide Type 7, U-bolt, as specified in Paragraph 15060, 2.02.B.
  5. Type 13s - Framing Channel Strap Restraint
    - a. Provide Type 13, framing channel pipe strap, as specified in Paragraph 15060, 2.02.B.
  6. Type 14s - Pipe Clamp Restraint
    - a. Provide with configuration and components equivalent to MSS and FEDSPEC Type 4.
    - b. Rod attachment and longitudinal brace connection stud shall be fabricated and welded by the manufacturer.
    - c. Steel pipe (insulated): Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.
    - d. Steel pipe (uninsulated): Superstrut No. S-720, Kin-Line No. S475, or equal.
    - e. Cast and ductile iron pipe: Superstrut No. S-720, Kin-Line No. S475, or equal.
    - f. Copper pipe (insulated): Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield.
    - g. Copper pipe (uninsulated): Superstrut No. S-720, Kin-Line No. S475, or equal, with insulation shield or dielectric lining.
    - h. Plastic pipe: Superstrut No. S-720, Kin-Line No. S475, or equal.
- C. Trapeze Restraints
1. General
    - a. Unless otherwise specified, provide trapeze members with a minimum steel thickness of 12-gage, with a maximum deflection 1/240 of the span.

2. Type 20s - Single Channel Lateral Restraint
    - a. Trapeze restraint cross member
      - 1) 1-5/8" square framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal.
    - b. Pipe attachments
      - 1) Type 13s or Type 7s specified in Paragraph 2.02.B.
    - c. Rod stiffeners and lateral brace
      - 1) As specified in Paragraph 2.02.D.
  3. Type 21s - Double Channel Lateral Restraint
    - a. Trapeze restraint cross member
      - 1) a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal.
      - 2) Pipe attachments
        - a) Type 13s or Type 7s specified in Paragraph 2.02.B.
    - b. Rod stiffeners and lateral brace
      - 1) As specified in Paragraph 2.02.D.
  4. Type 22s - Double Channel Longitudinal Restraint
    - a. Trapeze restraint cross member: a double channel manufactured assembly such as Unistrut P1001, B-Line B22A, Superstrut A-1202, or equal.
    - b. Pipe attachments
      - 1) Type 13s or Type 7s specified in Paragraph 2.02.B.
    - c. Rod stiffeners, longitudinal and lateral braces
      - 1) As specified in Paragraph 2.02.D.
- D. Braces and Fittings
1. Seismic Brace Fitting
    - a. Provided for use with industry standard framing channel.
    - b. Provide welded construction, two-piece linked fitting.
    - c. Provide means to reduce noise and vibration transmission between the linked fitting parts.
    - d. Manufacturers
      - 1) Superstrut C-749N series seismic brace,
      - 2) Kin-Line No. 633 seismic connector fitting,
      - 3) or equal as defined in Section 01330.
  2. Hanger Rod Stiffener Assembly
    - a. Rod stiffener channel
      - 1) 1-5/8" square framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, or equal.
    - b. Rod stiffener clamps, complete with channel nut
      - 1) Superstrut ES-142, Kin-Line No. 635, or equal as defined in Section 01330.

3. Type A1 Seismic Brace
    - a. Provide 1-5/8" square framing channel, Unistrut P1000, B-Line B22, Superstrut A-1200, Kin-Line No. 4112, or equal as defined in Section 01330.
  4. Type A2 Seismic Brace
    - a. Provide 1-5/8" wide by 3-3/4" deep framing channel, Unistrut P5000, B-Line B11, Superstrut H-1200, Kin-Line No. 8212, or equal as defined in Section 01330.
- E. Structural Attachments
1. General
    - a. Unless otherwise specified, provide hanger rod structural attachments as specified in Section 15060.
    - b. Structural attachments for longitudinal and lateral seismic braces: as specified in Paragraph 2.02.D.
  2. Type SA-1 Attachment
    - a. Brace fitting: as specified in Paragraph 2.02.D.
    - b. Concrete anchors
      - 1) As specified in Section 05501 with embedment and location dimensions as specified.
  3. Type SA-2 Attachment
    - a. Brace fitting: as specified in Paragraph 2.02.D.
    - b. Concrete anchors
      - 1) As specified in Section 05501 with embedment and location dimensions as specified.
    - c. Framing channel
      - 1) As specified in Paragraph 2.02.F.
  4. Type SA-3 Attachment
    - a. Brace fitting
      - 1) As specified in Paragraph 2.02.D.
    - b. Cap screw, lockwasher and hex nut materials and finish: compatible with structural steel material.
  5. Type SA-4 Attachment
    - a. Brace fitting
      - 1) As specified in Paragraph 2.02.D.
  6. Type SA-5 Attachment
    - a. Brace fitting
      - 1) As specified in Paragraph 2.02.D.
      - 2) Angle: 4" x 3" x 3/8".

F. Accessories

1. Hanger Rods

- a. Threaded on both ends or continuous threaded and sized as specified.

2. Framing Channel

- a. Roll formed, 12-gage.  
b. Provide channel with a continuous slot along one side with in-turned clamping ridges.  
c. Manufacturers  
1) Unistrut P1000 series,  
2) B-Line B22 series,  
3) Superstrut A-1200 series,  
4) or equal as specified in Section 01330.

3. Rod Coupling

- a. Provide with sight hole in center of coupling body.  
b. Manufacturers  
1) Anvil International. 135,  
2) Superstrut H-119,  
3) or equal as specified in Section 01330.

2.03 THERMAL PIPE HANGER SHIELD

- A. Provide thermal shields at seismic restraint locations on pipe requiring insulation.  
B. Provide thermal pipe hanger shields as specified in Section 15060, 2.03.  
C. Provide Type 316 stainless steel band clamps on thermal shields at longitudinal pipe restraint locations.

**PART 3 - EXECUTION**

3.01 PIPE RESTRAINT LOCATIONS

- A. Locate the first seismic restraint on a piping system not more than 10' from the main riser, entrance to a building or piece of equipment.  
B. Brace cast iron pipe on each side of a change in direction of 90° or more. Brace or stabilize joints in risers between floors.  
C. Brace no-hub and bell and spigot cast iron soil pipe longitudinally every 20' and laterally every 10'.  
D. Lateral bracing for one pipe section may also act as longitudinal bracing for the pipe section connected perpendicular to it, if the bracing is installed within 24" of the elbow or tee of the same size.  
E. Indicate seismic restraint locations and components on the piping layout drawings required by Section 15050.  
F. Provide a legend giving load information and restraint component selection at each restraint location.



- G. Provide seismic restraint load calculations conforming to the requirements specified in Paragraph 1.06.

### 3.02 INSTALLATION

- A. Use rod stiffener assemblies at seismic restraints for hanger rods over 6" in length. Provide a minimum of two rod stiffener clamps on any rod stiffener assembly.
- B. Install lateral and longitudinal bracing between 45° above and 45° below horizontal, inclusive, relative to the horizontal centerline of the pipe.
- C. Construct welded and bolted attachments to the building structural steel which comply with the AISC Manual of Steel Construction. Do not drill or burn holes in the building structural steel without approval of the Construction Manager
- D. Use embedded anchor bolts instead of concrete inserts for seismic brace installations in areas below water surface or normally subject to submerging.
- E. Install thermal pipe hanger shields on insulated piping at required locations during restraint installation. Make butt joint connections to pipe insulation at the time of insulation installation per the manufacturer's recommendations.
- F. Provide restraint components in contact with plastic pipe which are free of burrs and sharp edges.
- G. Ensure rollers roll freely without binding.
- H. Provide plastic or rubber end caps at the exposed ends of all framing channels that are located up to 7' above the floor.

### **END OF SECTION**

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## SECTION 15110

### GENERAL REQUIREMENTS FOR VALVES

#### PART 1 - GENERAL

##### 1.01 SECTION INCLUDES

- A. Requirements for valves.

##### 1.02 REFERENCED SECTIONS

- A. The following Sections are referenced in this Section:
  - 1. Section 01330 – Submittals
  - 2. Section 15050 – Piping Systems

##### 1.03 REFERENCED SPECIFICATIONS (NOT USED)

##### 1.04 SUBMITTALS

- A. Comply with Section 01330.
- B. Provide the following information, at a minimum:
  - 1. Shop drawings
    - a. Valves and actuators
  - 2. A schedule of valves indicating the label location, attachment method, and proposed label text for each valve.
  - 3. A schedule of responsible manufacturers for the project and contact information, planned site visits, and compliance tests to be performed.
  - 4. Design calculations, test and performance data, and other information required to substantiate that the valve units proposed will meet the performance requirements specified and shown.
  - 5. Protective Coatings: Manufacturer's data.

##### 1.05 DEFINITIONS

- A. Responsible Manufacturer: Manufacturer or manufacturer's representative who will ensure satisfactory performance of equipment.
- B. Valve: Device for mechanically regulating pipeline or open-channel flow.
- C. Actuator: Devices added to obtain mechanical advantage or power assist in operation.

##### 1.06 RESPONSIBLE MANUFACTURER

- A. Furnish, adjust, test, and ensure satisfactory performance of each valve.
- B. Provide any field adjustments, settings, and tests required for satisfactory performance of each valve at no additional cost to Owner.

## 1.07 QUALITY ASSURANCE

- A. Unless specified otherwise, factory test each valve body with a test pressure equal to twice the listed working pressure rating.
- B. Submit a certified copy of the pressure test reports for all valves over 12 inches in nominal size prior to shipping valves to the Site. Format these test reports per the requirements of the applicable reference standards.
- C. Storage and Preparation for Installation
  - 1. Package and store valves to prevent exposure to sunlight, chemical exposure, and atmospheric pollution.
  - 2. Inspect each valve prior to installation for damage. Repair any damage to seats, machined surfaces, or protective coatings before installation. Clean each valve to remove any dirt and debris from the interior surfaces and seat areas. Install valves in the closed position.
  - 3. Some valves must be installed with seats or seat adjustment rings on the downstream side of the valve. Determine these requirements prior to installation and install the valve in the correct orientation.

## PART 2 - PRODUCTS

### 2.01 GENERAL

- A. Provide valves, gates, actuators, stem extensions, and other accessories as indicated on the Drawings or specified. All valves shall be new and of current design. For valves of the same type, provide identical valves supplied by a single manufacturer.
- B. Provide valves and actuators with the name of the manufacturer, nominal size, flow direction arrow, design working pressure, and the reference standard cast in raised letters or indelibly marked on an appropriate part of the body.
- C. Provide valves and actuators designed for submerged service for the following locations
  - 1. Located outdoors
  - 2. Within a building below the adjacent finished grade
  - 3. In vaults
  - 4. Where otherwise indicated. All other units shall be weather-tight and suitable for outdoor service.
- D. Provide buried valves with valve boxes and covers where indicated.
- E. Flanges, gaskets, and bolts for valves: in accordance with Section 15050.
- F. Unless otherwise specified, all interior bronze parts of valves shall conform to the requirements of ASTM B62.
- G. Wetted parts shall be lead-free as defined by California AB1953, California Prop-65, or the most stringent of current regulations.

### 2.02 BALL VALVES

- A. Manufacturers
  - 1. R&G Sloane;
  - 2. Asahi/America Pro Block;

3. Or equal.
- B. Design
  1. Type: Double union.
  2. Pressure Rating: 150 psi at 75°F.
  3. Connections: Socket.
- C. Materials
  1. Body: PVC.
  2. Seats: Teflon.
  3. O-ring seals: EPDM, except Viton with chlorine solution.

## 2.03 PROTECTIVE COATINGS

- A. Coat ferrous surfaces in water passages of all valves of size 2 inches and larger and exterior surfaces of valves and actuators, with epoxy per AWWA C550, unless otherwise specified in the valve specification.
  1. Interior Surfaces:
    - a. Minimum dry film thickness: 8 mil
    - b. NSF/ANSI 61 approved.
  2. Exterior Surfaces:
    - a. Above ground:
      - 1) Minimum dry film thickness: 8 mil
    - b. Buried, submerged or in blow ground vaults:
      - 1) Minimum dry film thickness: 12 mil
- B. Do not coat flange faces or bronze and stainless steel surfaces in water passages.
- C. Coat exterior bronze and stainless steel surfaces using the same system as the associated piping.
- D. Provide holiday-free protective coatings.

## 2.04 VALVE ACTUATORS

- A. Furnish valves and gates with an actuator as indicated in the valve Technical Specification.
- B. Assemble valve actuators to the valve, adjust, and test the completed unit by Responsible Manufacturer prior to shipment to the Site.

# PART 3 - EXECUTION

## 3.01 VALVE INSTALLATION

- A. Install valves per the manufacturer's written instructions and as indicated on the Drawings and specified.
- B. Fit, support and brace gates to prevent warping, binding, and bending under all operating conditions. Accurately position and support embedded parts cast into concrete during concrete placement.

C. Assembly of Valves and Piping

1. Install valves with piping per this Section.
2. Install valves with piping prior to the assembled piping or attached supports being cast into concrete or attached to supports.
3. Sequence construction and operations so that the adjacent piping supports the valves, and so that the valves do not support the piping. Where permanent supports are located at valves, install the supports after the piping and valves have been installed as a completed assembly on temporary supports.
4. Install piping and valve assemblies so that the piping does not exert forces on the valves from settlement or assembly operations.
5. Correct piping alignment deviations before the valve is joined to the piping.
6. Unless shown otherwise, install butterfly, plug, and ball valves with the shafts in the horizontal position.
7. Install gates, gate valves, and other types of valves with the stems in the vertical position.
8. For manually operated valves 3 inches in nominal size and smaller, orient the valve operators and indicators to be visible to the operator.

- D. Install floor boxes, valve boxes, extension stems, and floor stands vertically centered over the operating nut, with couplings as required. Adjust the elevation of the box top to conform with the elevation of the finished floor, grade, or pavement at the completion of the Work. Support boxes and stem guides during concrete placement to maintain vertical alignment and proper orientation.

3.02 TESTING

- A. Pressure test valves as part of the pipeline testing. Demonstrate valve operation (open/close) after the valve is installed including valve box and riser, as appropriate.
- B. Following installation, Owner may conduct holiday test for valves larger than 30-inch.

**END OF SECTION**

## **SECTION 15117**

### **PRESSURE RELIEF VALVES FOR STRUCTURES**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Pressure relief valves specified in this section shall be the type designed to limit the uplift pressure of groundwater on tanks and other structures.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section:
  - 1. Section 01330 – Submittals
  - 2. Section 11000 – General Requirements for Equipment

##### **1.03 SUBMITTALS**

- A. Submit in accordance with Section 01330.

##### **1.04 PERFORMANCE DURING TESTING OF STRUCTURES**

- A. The valves specified in this section are expected to leak. During hydrostatic testing of structures, after evaluating the status and effect of groundwater conditions during the proposed test, the Contractor may seal the valves for the duration of the test. They shall be in a clean, like new condition when the work is accepted.

#### **PART 2 - PRODUCTS**

##### **2.01 GENERAL**

- A. Pressure relief valves for structures shall be similar to James B. Clow and Sons No. F 1492, Coldwell-Wilcox Type A, Neenah Foundry Company No. R-5000 Type C, or equal, except that the valves shall be provided with replaceable neoprene gaskets cemented to both the cover and body seats. Each valve shall be tested before shipment.

##### **2.02 MATERIALS**

- A. Materials of construction shall be as follows:
  - 1. Cover and valve body: Cast Iron
  - 2. Gasket: Neoprene, ASTM D2000, CA410
- B. Materials specified are considered the minimum acceptable for the purposes of durability, strength, and resistance to erosion and corrosion. The Contractor may propose alternative materials for the purpose of providing greater strength or to meet required stress limitations. Alternative materials, however, must provide at least the same qualities as those specified for the purpose.

##### **2.03 SPARE PARTS**

- A. Five sets of gaskets and required amount of bonding material shall be provided. Spare parts shall be tagged and stored in accordance with Section 11000.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Pressure relief valves shall be installed in accordance with the manufacturer's printed recommendations.

### **3.02 CLEANING AND TESTING**

- A. Prior to start-up and commissioning, the Contractor shall, for each valve, clean both seats and the screen and raise and lower the cover to demonstrate it is free to operate.

**END OF SECTION**



## **SECTION 15119**

### **MISCELLANEOUS SPECIALTY VALVES**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Specialty valves not specified in other specification Sections.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section:
  - 1. Section 01330 – Submittals
  - 2. Section 01782 – Operation and Maintenance Information

##### **1.03 SUBMITTALS**

- A. Comply with Section 01330.
- B. Product Data: Submit Manufacturer's standard product data for each type of valve.
- C. Applicable operating and maintenance information specified in Section 01782.

#### **PART 2 - PRODUCTS**

##### **2.01 PLASTIC BODY DIAPHRAM VALVES**

- A. Service: Use plastic body diaphragm valves in the following service applications:
  - 1. Sodium hypochlorite (CL).
  - 2. Sodium hydroxide (SH)
  - 3. Alum (ALUM)
  - 4. Drains, Chemical (CD, DR, D)
- B. Manufacturers: One of the following, or equal:
  - 1. Asahi America.
  - 2. Chemtrol.
  - 3. Simtech.
- C. Materials
  - 1. Body: HDPE or CPVC with reinforcing ribs at end connections.
  - 2. Diaphragm: Unless otherwise specified below, provide Teflon diaphragm with EPDM backing.
    - a. Sodium Hypochlorite Service: Use 3 diaphragm layers: Teflon (PTFE), PVDF, and EPDM.
  - 3. Bonnet: Reinforced polypropylene with cast iron or silicon bronze drive nut, acrylic protective cap, and visual position indicator.
  - 4. Handwheel: Polypropylene.

5. Stem: Stainless steel with adjustable stainless steel travel stop nut.
  6. Flange Gaskets: Suitable for the intended service unless specifically identified below.
    - a. For Sodium Hypochlorite Service: Hypalon.
- D. Valve Design
1. Type: Weir type diaphragm valve.
  2. End Connections: Flanged.
  3. Operator Handle: Handwheel with position indicator and adjustable travel stop to avoid over tightening. Provide acrylic stem cap.
  4. Pressure Rating: 150 psi.
- E. Manufacturers: Haws Model 9201H, or equal.

## 2.02 HOSE VALVES

- A. Type: Brass angle valve with composition disc and threaded adapter for hose connection.
- B. Manufacturers: One of the following, or equal:
1. Crane Model 17.
  2. Lunkenheimer Model 214.
  3. Powell Model 151.
- C. Hose Valves on Potable Water Systems: Provide with a non-removable backflow prevention device conforming to requirements of the Uniform Plumbing Code.

## 2.03 DE-GASSING VALVES

- A. Service: Use plastic body de-gassing valves for sodium hypochlorite
- B. Manufacturers: One of the following, or equal:
1. Plast-O-Matic.
  2. Accu-Vent.
  3. Or equal.
- C. Materials
1. Body: PVC or CPVC.
  2. Seals: FKM.
  3. Wetted Float: Natural Polypropylene.
- D. Valve Design
1. Type: De-gassing.
  2. End Connections: Flanged.
- E. Pressure Rating: Maximum - 100 psi. Closes at 0 psi.

2.04 PRESSURE REGULATING VALVES

- A. Service: 3W
- B. Type: Valves less than 1-1/4 inches shall be direct acting, spring-operated type.
- C. Manufacturers: Valves less than 1-1/4 inches shall be Cash-Acme E-41 Series 3, Watts 223, or equal, with separate Y-pattern strainer.

**PART 3 - EXECUTION**

3.01 INSTALLATION

- A. Clean interior of valve and valve end joints before installation.
- B. Install valve in accordance with the manufacturer's recommendations.

**END OF SECTION**

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## **SECTION 15141**

### **STEEL PIPE**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Steel pipe and fittings.
- B. See Section 15050 for service applications for non-potable and recycled water.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 01330 – Submittals
  - 2. Section 09900 – Coating Systems
  - 3. Section 15050 – Piping Systems
  - 4. Section 15996 – Testing Pressure Pipe

##### **1.03 SUBMITTALS**

- A. Comply with Section 01330.
- B. Include the following items:
  - 1. Affidavits of Compliance with AWWA C200, AWWA C205, AWWA C206, AWWA C207, ASTM A53, or ASTM A106 as applicable.
  - 2. Shop drawings, product data sheets, information for linings and coatings.
  - 3. Fittings and special details such as elbows, wyes, tees, outlets, connections, test bulkheads, and nozzles or other specials where shown on the Contract Drawings which indicate amount and position of all reinforcement. All fittings and specials shall be properly reinforced to withstand the internal pressure, both circumferential and longitudinal, and the external loading conditions as indicated in the Contract Documents.
  - 4. Records of the hydrostatic shop tests or radiographic testing records for each pipe shall be made and certified copies submitted.
  - 5. Production welds on factory manufactured pipe shall be tested in accordance with AWWA C200 and test results submitted.
  - 6. Quality Control
    - a. Welders qualifications

##### **1.04 QUALITY ASSURANCE**

- A. Factory test per ASTM A53 or ASTM A106 as applicable.

## 1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Straight Pipe Sections: Support pipe sections on a minimum of two padded saddles, spaced at intervals not exceeding 20 feet. Provide saddles with a width that provides at least a 90-degree contact angle. Pipe sections shall be separated so they do not bear against each other.
- B. Fabricated Specials: Support on padded saddles, and crate as necessary to protect fabricated assembly.
- C. Pipe ends shall be tightly closed with a plastic wrap for protection of the cement-mortar lining during shipment. The plastic wrap shall consist of a 10-mil sheet of polyethylene plastic and shall remain on the pipe until the time of installation.
- D. Handling and Storage
  - 1. Handle pipe using slings, padded cradles or other devices that will not cause damage to the pipe. Do not use chains, hooks, metal bars, narrow skids or other equipment, which might damage the pipe, fittings, or specials.
  - 2. Do not roll pipe during handling operations.
  - 3. Do not stack pipe.
  - 4. All pipe, fittings, etc., shall be carefully handled and protected against damage to the lining and coating on interior and exterior surfaces, impact shocks, and free fall.
- E. Provide adequate stulling and cross bracing for all pipe sections to prevent damage during handling, storage, hauling, and installation.
- F. Shop Fabrication: Fabricate piping sections in the shop and pickle and passivate at point of manufacture.
- G. No pipe shall be installed where the lining or coating/interior or exterior surfaces show cracks that may be harmful as determined by the Owner. Such damaged lining or coating/interior and exterior surfaces, shall be repaired, or a new undamaged pipe shall be furnished and installed by the Contractor at no cost to the Owner.

## PART 2 - PRODUCTS

### 2.01 PIPE MATERIALS

- A. Provide steel pipe per AWWA M-1, ASTM A53, ASTM A106, or AWWA C200 as indicated.
- B. All materials (pipe, fittings, gaskets, linings, etc.) in contact with potable water shall be lead-free and NSF 61 certified.
- C. Steel pipe
  - 1. Pipe diameters 4-12 inch: Schedule 40 conforming to ASTM A53, Grade B or A106, Grade B unless otherwise indicated.
  - 2. Pipe diameters 14-144 inch: Spiral or straight seam conforming with AWWA C200.
    - a. Minimum plate thickness for pipe shall be 1/4-inch.
    - b. Conform to the requirements of ASTM A36; ASTM A572, Grade 42; ASTM A570, Grades 33 and 36; or ASTM A283, Grade D.

- D. Pipe Diameter
  - 1. Pipe diameter 4-12-inch: Nominal Schedule 40 pipe diameter.
  - 2. Pipe diameter 14-144 inch: Inside diameter to match the pipe diameter indicated.
- E. Each length of pipe shall be plainly marked inside and out to identify the design pressure, the steel wall thickness, the date of manufacture, and the proper location of the pipe by reference to the layout schedule.

## 2.02 FITTING AND APPURTENANCES

- A. Dimensions shall be per AWWA C208.
- B. Rated for 150 psi, as a minimum working pressure.
- C. Pipe diameter 4-12 inch: Schedule 40 wrought steel butt welded in accordance with ANSI B16.9 conforming to ANSI A234
  - 1. Elbows:
    - a. Radius: minimum 2.5 diameter of pipe.
    - b. Miter section angle: 22.5 degree.
- D. Collars, wrapper plates, crotch plates, and other fittings shall be designed in accordance with AWWA M11.
- E. Cement-mortar lining and inside diameter shall be the same as for the specified pipe.

## 2.03 JOINTS

- A. Joints for steel pipe shall be flexible couplings, flanged, bell and spigot, lap welded, butt-welded, or welded butt straps as shown.
- B. Pipe with field welded joints shall be installed in accordance with AWWA C206.
- C. Welding operators, procedures, and details shall be qualified in accordance with AWWA C206.
- D. Flanges where shown shall be slip-on or weld neck per AWWA C207, Class D, 125 lb. Final machining on the contact faces of all flanges shall be done prior to being welded to the full length of the adjacent steel plate section. Flange faces shall be checked with a straight edge and shall be perpendicular to the pipeline. All warped flanges will be returned to the pipe company for adjustment. Contractor shall be responsible for all additional expenses and delays associated with required flange adjustments.
  - 1. Nuts and bolts shall be of the sizes and quantities recommended in AWWA C207. Nuts and bolts shall be Type 316 stainless steel confirming to ASTM A193, Grade B8M, for bolts and ASTM A194, Grade 8M, for nuts. The length of each bolt shall be such that between 1/4-inch and 1/2-inch will project through the nut when drawn tight.
  - 2. Gaskets for flanged joints shall be cloth-inserted sheet rubber gaskets in one piece conforming to AWWA C207 and ANSI B16.21, 1/8-inch thick.
  - 3. The gasket shall be full-face, with pre-punched holes to pass bolts.
  - 4. Gasket material shall be free from corrosive alkali or acid ingredients and suitable for use in potable water lines.
  - 5. Segmented straight-joint or interlocking gaskets will not be accepted.

6. Blind flanges shall be gasketed with the entire face with the gasket cemented to the blind flange.
  7. Gaskets shall be NSF 61 certified for potable water applications.
  8. Gaskets for push-on, mechanical, and restrained joints shall be synthetic rubber in accordance with AWWA C111.
- E. Flexible couplings (pipe sleeves) and flanged coupling adapters shall be furnished and installed by the Contractor.
1. All couplings shall be suitable for a minimum working pressure of 150 psi.
  2. Flexible couplings for steel pipe shall be Smith-Blair Series 411, Romac Style 400, or equal.
  3. Flanged coupling adapters shall be Smith-Blair Series 913, Romac Style RC400, or equal.
  4. Sleeves shall be ten inches minimum length and have a fusion bonded epoxy coating suitable for potable water.

## 2.04 PIPE LINING

### A. Epoxy

1. Line pipe and fittings with a liquid epoxy complying with AWWA C210, with the following exceptions:
  - a. Do not incorporate coal tar products in the liquid epoxy.
  - b. The curing agent may be an amidoamine as well as the other curing agents listed in AWWA C210.
2. Applied to a minimum thickness of 16 mils in not less than 2 coats.

### B. Cement Mortar

1. Where specified, line pipe and fittings with cement mortar as specified in AWWA C205.
2. Inside joints of pipe 24-inches and larger shall be cleaned and thoroughly wetted before being filled with stiff cement mortar and finished smooth by toweling or other equivalent method.
3. Cement for cement-mortar lining shall be ASTM C150, Type II of V.

## 2.05 PIPE COATING

### A. Epoxy

1. Where specified, coat pipe and fittings with a liquid epoxy as specified in AWWA C210 with the following exceptions:
  - a. Do not incorporate coal tar products in the liquid epoxy.
  - b. The curing agent may be an amidoamine as well as the other curing agents listed in AWWA C210.
2. Apply to a minimum thickness of 16 mils in not less than two coats.



B. Polyethylene Tape

1. Where specified, coat and wrap pipe and fittings with prefabricated multilayer cold applied polyethylene tape coating per AWWA C214.
2. Apply as a continuous step operation in complying with AWWA C214, Section 3.
3. Total coating thickness: not less than 50 mils for pipe 24 inch and smaller, and not less than 80 mils for pipe 26 inch and larger.

C. Cement Mortar

1. Where specified, coat pipe and fittings with cement mortar as specified in AWWA C205.
2. The outside joints of cement mortar coated pipe shall be coated with cement-mortar retained by diapers so as to bridge the joint and maintain the specified minimum coating thickness over the joint. The mortar shall be compacted within the diaper to produce a dense coating without any voids.
3. Cement for cement-mortar coating shall be ASTM C150, Type V.

2.06 FUSION EPOXY COATING AND LINING

A. Where specified, coat and line steel pipe and fittings with fusion epoxy.

1. Manufacturer: 3M Scotchkote 203, or equal.
2. Surface preparation: Comply with SSPC-SP 10 Near White Blast Cleaning.
3. Application method: Fluidized bed method.
4. Minimum dry film thickness: 12 mils

B. Coat and patch field welds, connections and otherwise damaged areas with 3M Scotchkote 306 per manufacturer's instructions.

2.07 DIELECTRIC ISOLATION

A. Piping shall be dielectrically isolated from piping or other materials constructed from dissimilar metals.

B. Flange dielectric insulation sets shall contain full faced gaskets, full length sleeves, and double insulating washers or as specifically indicated on the Plans.

1. Insulation material for the flange insulation sets shall be phenolic resin and flange faced gaskets shall be neoprene faced phenolic resin.
2. Insulating materials shall be of a type designated by the manufacturer as suitable for use at the operating and test pressures specified for the type of pipe on which the materials are to be installed.

C. Insulating flange gasket sets shall be installed at the specified locations.

1. Clean insulating components of dirt, grease, oil, and other foreign materials immediately prior to assembly.
2. Properly align bolt holes in mating flanges at the time bolts and insulating sleeves are inserted to prevent damage to the insulation.
3. After flanged bolts have been tightened, inspect each insulating washer for cracks or other damage.

4. Replace damaged washers
- D. After assembly, measure resistance between each bolt and flange with an approved ohmmeter; minimum resistance shall be 50,000 ohms. All insulating flanged joints shall be coated.

### **PART 3 - EXECUTION**

#### **3.01 FABRICATION**

- A. Fabrication shall comply with ASME B31.3. Welding procedure and performance qualifications shall be in accordance with Section IX, Articles II and III, respectively, of the ASME Boiler and Pressure Vessel Code.

#### **3.02 INSTALLATION**

- A. General
  1. Install per AWWA M11, Chapter 12.
  2. Welded joints: Comply with AWWA C206.
  3. Sleeve-type mechanical pipe couplings: Comply with AWWA M11.
  4. Pipe lining and coatings at field joints shall be applied as specified in Paragraphs 2.05 and 2.06.
  5. Unless otherwise specified, buried mechanical couplings and valves shall be field coated as specified in Section 09900.

#### **3.03 TESTING**

- A. Hydrostatic testing: Comply with Section 15050 and Section 15996.
- B. Not Used.
- C. Conduct the tests in the presence of the Construction Manager.

### **END OF SECTION**

## **SECTION 15162**

### **REINFORCED CONCRETE PIPE**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Reinforced concrete pipe in sizes equal to or greater than 12 inches in nominal diameter.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section:
  - 1. Section 01330 – Submittals
  - 2. Section 02320 – Trenching

##### **1.03 DEFINITIONS**

- A. Pipe Joint: The area approximately 12 inches each way from the centerline of the visible gap between pipe lengths.
- B. Pipe Length: The pipe between two joints; part of a pipe section.
- C. Pipe Section: The reach of pipeline between two successive manholes.

##### **1.04 SUBMITTALS**

- A. Submit in accordance with Section 01330.
- B. Fabrication Drawings
  - 1. Details of wall thickness, pipe joint, joint gasket, and reinforcement.
  - 2. Reinforcement Details: Type and location of the reinforcement cages in the pipe wall, the size and spacing of circumferential and longitudinal reinforcing steel, and the cross-sectional area of reinforcing steel in each cage per lineal foot of pipe.
  - 3. Gasket Details: Diameter of the cross section and material.
- C. Test results.

##### **1.05 SHIPPING AND HANDLING**

- A. Ship pipe with adequate blocking to support pipe sections and to prevent damage to bells and pipe ends.
- B. Carefully handle pipe during loading, unloading and installation. Lower pipe sections by mechanical means. Do not drop pipe sections.
- C. Protect gaskets from long term exposure to sunlight.
- D. Store pipe sections so that they do not accumulate rainwater, dirt and debris.

##### **1.06 QUALITY ASSURANCE**

- A. Concrete Compression Tests: Conduct tests in accordance with ASTM C76, Section 11.4.1.

B. D-Load Tests

1. Test pipe in accordance with ASTM C76, Section 11.3 and ASTM C497. Loads used for testing shall be the load to produce the 0.01” crack or the design test load, whichever is less.
2. Sample Size: Test 1 percent of the total number of pipes, with a minimum of 3 pipe lengths, of each class, size and wall type.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Pipe equal to or greater than 12 inches in nominal diameter: Conform to ASTM C76, Class V.
1. Cement: ASTM C150, Type II.
- B. Gaskets: Conform to ASTM C443, Section 5.

### **2.02 MANUFACTURE**

A. Pipe Sections

1. Fabricate pipe in nominal lengths of at least 8 feet except where shorter lengths are required to meet special conditions.
2. Pipe ends may be beveled a maximum of 5 degrees to accommodate changes in alignment or curved alignments of the pipeline.
3. Manufacture pipe by the centrifugally spun or vertically wet cast method and manufactured in conformance with ASTM C76.
  - a. Pipe manufactured by the vertically wet cast method shall be cast with the spigot end down.
4. Securely hold reinforcing steel for each length of pipe in place throughout the casting operation. Lift holes are not acceptable.

B. Pipe Joints

1. Type: Either concrete bell and spigot or a double spigot and sleeve.
  - a. When double spigot and sleeve type joints are used, fabricate the sleeve from a reinforced Thermoset plastic collar or a steel band. If the steel band is provided, a minimum of 12 mils of coal tar epoxy shall be applied in two coats of 6 mils minimum per coat.
2. Joint Gaskets: Rubber gasket conforming to ASTM C443, unless otherwise specified.

## **PART 3 - EXECUTION**

### **3.01 INSPECTION**

- A. Inspect pipe sections for acceptable condition. Pipe may be rejected by Engineer under the following conditions:
1. Fractures or cracks passing through the wall, except for a single end crack that does not exceed the depth of the joint.

2. Surface defects including honeycombs, open texture and other defects and abnormalities.
3. Ends of the pipe are not normal to the walls and centerline of the pipe.
4. Damaged or cracked ends where such damage would prevent making a satisfactory joint.
5. Any continuous crack having a surface width of 0.01 inch or more and extending for a length of 12 inches or more, regardless of position in the wall of the pipe.

### 3.02 PIPE LAYING

- A. Prepare bedding and place trench backfill in accordance with Section 02320 and the details indicated on the Drawings.
- B. Lay pipe by proceeding upgrade with the spigot ends in the direction of the flow.
- C. Lay pipe with uniform bearing under the full length of the barrel of the pipe.
- D. Clean the interior of the pipeline as the work progresses.
- E. Keep assembled pipe joints in compression until the placement of the initial backfill is complete. Joint characteristics for acceptability include:
  1. Fit close and tight.
  2. Smooth and uniform interior surface.
  3. Secure and hold adjoining sections of pipe together.
  4. Fasten securely to structures.

### 3.03 LINE AND GRADE TOLERANCES

- A. Control pipe bedding and pipe installation procedures to comply with the following line and grade tolerances:
  1. Line and grade variance from established line and grade indicated on the Drawings: Not greater than 1/32-inch per inch of nominal pipe diameter.
  2. Maximum Variance: No more than 1/2-inch from established line and grade indicated on the Drawings.
  3. The allowable variance is not cumulative.
- B. Variance from line and grade shall not result in a level or reverse sloping invert.

### 3.04 CONCRETE CLOSURES

- A. Use concrete closure collars only when approved by the Engineer.
- B. Field conditions in which concrete closures may be acceptable:
  1. Connections between dissimilar pipes.
  2. Connections where standard manufactured couplings are not available.

### 3.05 REPAIR OF DAMAGED PIPE

- A. Damaged pipe that does not meet the criteria for rejection shall be repaired.

- B. Repair damaged pipe in accordance with ASTM C361 except use epoxy bonding agent to bond mortar to concrete.

**END OF SECTION**

**SECTION 15250**  
**PIPE INSULATION**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Piping insulation.

1.02 REFERENCED SECTIONS

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals

1.03 REFERENCED STANDARDS

- A. American Society for Testing and Materials (ASTM)
  - 1. C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
  - 2. C547 – Standard Specification for Mineral Fiber Pipe Insulation
  - 3. C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
  - 4. E84 – Standard Test Method for Surface Burning Characteristics of Building Materials
  - 5. E96 – Standard Test Methods for Water Vapor Transmission of Materials
- B. National Fire Protection Association (NFPA)
  - 1. 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials

1.04 SUBMITTALS

- A. Comply with Section 01330.
- B. Product technical data including:
  - 1. Acknowledgement that products submitted meet requirements of standards referenced.
  - 2. Manufacturer's installation instructions.
  - 3. Submit complete specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
- C. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
- D. Certifications: Products will meet the requirements of the Contract Documents.

## **PART 2 - PRODUCTS**

### **2.01 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
  - 1. Elastomeric insulation:
    - a. Rubatex.
    - b. Armstrong.
    - c. Or equal.
  - 2. Fiberglass insulation:
    - a. Certainteed Corporation.
    - b. Schuller (Manville).
    - c. Owens Corning.
    - d. Knauf.
    - e. Or equal.
  - 3. PVC jacket:
    - a. Ceel-Co.
    - b. PIC Plastics.
    - c. Or equal.
- B. Submit request for substitution in accordance with Section 01330.

### **2.02 PIPING INSULATION - ELASTOMERIC**

- A. General:
  - 1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84 (UL723), NFPA 255, not exceeding:
    - a. Flame spread: 25.
    - b. Smoke developed: 100.
  - 2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.
  - 3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.
  - 4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
    - a. Water-soluble treatments are prohibited.
  - 5. Insulated shields at pipe support points.
- B. Pipe, Fitting, and Valve Insulation:
  - 1. Flexible elastomeric closed cell pipe insulation.
    - a. ASTM C534, Grade I.



- b. Average thermal conductivity not to exceed 0.28 (Btu-IN)/(HR-FT<sup>2</sup>-DegF) at mean temperature of 75 DegF, temperature range -40 to 220 DegF; permeability not to exceed 0.20 by ASTM E96; water absorption 3 percent and ozone resistance.
- 2. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

## 2.03 PIPING INSULATION - FIBERGLASS

### A. Pipe and Fitting Insulation:

- 1. Preformed fiberglass pipe insulation:
  - a. ASTM C547 Type I:
    - 1) Density: 4 LBS/CF.
    - 2) Temperature rated: 650 DegF.
    - 3) Average thermal conductivity not to exceed 0.24 (Btu-IN)/(HR-FT<sup>2</sup>-DegF) at mean temperature of 75 DegF.
    - 4) Fire hazard rating:
      - a) ASTM E84 (UL723), NFPA 255.
      - b) Flame spread not exceeding 25 and smoke developed not exceeding 100.
- 2. Moisture adsorption:
  - a. ASTM C553.
  - b. Not greater than 0.5 percent moisture by volume when exposed to moisture laden air at 120 DegF and 96 percent RH.
- 3. Fungi and bacteria resistance:
  - a. ASTM C665.
  - b. Does not breed or promote growth.
  - c. Flame attenuated glass fibers bonded with thermosetting resin.
- 4. Piping jackets (general applications):
  - a. Aluminum: 16 mil embossed aluminum.
  - b. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B.F. Goodrich PVC sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do not exceed the limits of PVC.
  - c. Piping jacket not required on concealed piping.
- 5. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

## 2.04 SUBSTITUTION

- A. Submit request for substitution in accordance with Section 01330.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

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

B. General:

1. Consider piping as exposed, except as otherwise indicated.
2. Provide release for insulation application after installation and testing is complete.
  - a. Apply insulation on clean, dry surfaces after inspection.
3. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
4. Provide insulation with vapor barrier for piping where surfaces may be cooler than surrounding air temperatures.
  - a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
  - b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
5. Apply specified adhesives, mastics and coatings at the manufacturer's recommended overage per unit volume.

C. Piping Insulation - Elastomeric:

1. Slip insulation on pipe prior to connection.
  - a. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
2. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
3. Seal joints, slits, miter-cuts and other exposed edges of insulation with adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.

D. Piping Insulation - Fiberglass:

1. Apply over clean dry pipe.
  - a. Butt all joints together firmly.
2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
4. PVC pipe jacket:
  - b. Apply jacketing with a minimum of 1-inch overlap.
    - 1) Weld longitudinal and circumferential seams with adhesives as recommended by manufacturer.
  - c. Provide slip-joints every 30 feet and between fittings if distance exceeds 8 feet.
    - 1) Construct slip-joints by overlapping jacket sections 6 to 10 inches.
  - d. Provide premolded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.

5. Aluminum pipe jacket:
- a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
  - b. Provide smooth and straight joint with a minimum 2-inch overlap.
  - c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 inches back from edge.
  - d. Center spacing of screws 5 inch maximum or as required to provide smooth tight-fitted joints.
  - e. Place joints on least exposed side of piping to obtain neat appearance.

### 3.02 REPAIR

- A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship

### 3.03 SCHEDULES

- A. Pipe, Fittings and Valves:
1. Use preformed fiberglass.
  2. Schedule:

Application	Pipe Size	Thickness, inch	Jacket
ALUM, 3W, HCS	Less than 2 inches	1.0	Exterior Conditions

**END OF SECTION**

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## **SECTION 15951**

### **TESTING GRAVITY FLOW PIPELINES**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Acceptance testing of gravity flow pipelines, including:
  - 1. Visual inspection of pipes.
  - 2. Leakage testing of pipes.
  - 3. Leakage testing of manholes.

##### **1.02 REFERENCED SECTIONS**

- A. The following Section is referenced in this Section
  - 1. Section 01330 – Submittals

##### **1.03 PERFORMANCE REQUIREMENTS**

- A. Perform leakage testing to verify compliance with the maximum allowable leakage criteria specified in this Section. Refer to tables in this Section for leakage criteria.
- B. Repair or replace sections of pipelines and manholes that fail to meet the specified requirements and retest until the leakage criteria is satisfied.

##### **1.04 SUBMITTALS**

- A. Comply with Section 01330.
- B. Before testing begins and in adequate time to obtain approval through the submittal process, prepare and submit a test plan for review by the Engineer. Include testing procedures, methods, equipment, and tentative schedule.
- C. Submit test reports for each test on each segment of pipeline.

##### **1.05 SEQUENCE AND SCHEDULING**

- A. Perform testing after placing and compacting Bedding Material around the pipe, or after backfilling the pipe trench, at Contractor's option. Schedule testing so that no more than 1,000 lineal feet of installed gravity flow piping remains untested at any one time.
- B. Coordinate testing schedules with Engineer. Perform testing under observation of Engineer.

#### **PART 2 - NOT USED**

#### **PART 3 - EXECUTION**

##### **3.01 PREPARATION**

- A. Provide labor, equipment, tools, test plugs, risers, air compressor, air hose, pressure gauges and other devices necessary for proper testing and inspection of pipelines.

- B. Test pressures shall account for ground water elevation.

### 3.02 TESTING LINE AND GRADE

- A. Confirm pipe alignment visually by flashing a light between manholes. Verify if alignment is true and no pipes are misplaced. In case of misalignment or damaged pipe, remove and re-lay or replace pipe segment.

### 3.03 LEAKAGE TESTING

- A. Test Options:

- 1. Test gravity flow pipes and manholes for leakage.
  - a. Gravity flow pipelines 24-inches in diameter and smaller may be tested by either hydrostatic means or by low pressure air testing.
  - b. Test gravity flow pipelines larger than 24-inches in diameter by hydrostatic means, low pressure air testing or joint testing.

- B. Compensating for Ground Water Pressure:

- 1. When Contractor elects to test pipe after backfilling the pipe trench, groundwater pressure must be taken into account to eliminate influence on the leakage test.
- 2. Determine groundwater elevation as follows:
  - a. Install a ½-inch diameter pipe nipple, approximately 10” long, through the wall of each manhole. Cap the end of the pipe nipple that protrudes into the manhole. Locate pipe nipple at the crown of the new gravity pipeline where the pipeline enters the manhole. Install pipe nipple at the same time the gravity pipeline is constructed.
  - b. Before performing pipeline leakage acceptance test, remove the cap from the pipe nipple and clear the pipe nipple with air pressure. Connect a clear plastic tube to the nipple, run the tube vertically inside the manhole and allow groundwater to rise in the tube.
  - c. After groundwater stops rising, measure the height in feet of water over invert of the pipe.

### 3.04 HYDROSTATIC LEAKAGE TESTS

- A. Determine groundwater elevation.
- B. Plug wyes, tees, stub outs, laterals and other connections to the sewer. Plug sewer pipeline in the downstream manhole. If necessary to isolate flow, plug incoming pipes in the upstream manhole.
- C. When test pressures require installation of a riser pipe, connect riser pipe to pipe in the upstream manhole.
- D. Fill sewer pipe and manholes with water to the specified test elevation, compensating for the measured groundwater elevation.
- E. Leakage Tests on Concrete Pipe
  - 1. After filling pipe with water, allow water to saturate concrete for four hours before beginning hydrostatic test.

2. After four hours, replace water lost through absorption into the pipe, re-filling to restore to the specified test pressure.
3. Conduct leakage test for a duration of 2 hours. After 2 hours, take water level reading to determine drop of water level and calculate water loss or measure the quantity of water required to restore water to the specified elevation. Total loss of water shall not exceed that calculated from allowable leakage criteria.
4. Allowable Leakage Criteria: Maximum allowable leakage equivalent to 200 gallons per day per inch of inside diameter per mile of pipeline under test.

### 3.05 LOW PRESSURE AIR TESTING

- A. Conduct air pressure testing in accordance with ASTM C924.
- B. When low pressure air testing is used to test concrete pipes, a wetted pipe interior is recommended.
- C. Pressurize the pipe section to be tested to 4.0 pounds per square inch and hold this pressure for 5 minutes. After this time period, allow pressure to drop.
- D. When internal air pressure reaches 3.5 pounds per square inch, begin measuring rate of air pressure loss. Record the time interval required for the internal air pressure to drop from 3.5 psi to 2.5 psi.
- E. Acceptance Criteria: The pipeline under test is acceptable when the time interval so recorded exceeds the minimum test time given by the following table:

MINIMUM Time Allowed for Pressure Loss from 3.5 psig to 2.5 psig:	
Nominal Pipe Diameter, Inches	Minimum Time Allowed per 100 Lineal Feet of Pipe Under Test, Minutes
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.8

- F. Any section of pipe which fails to meet requirements shall be repaired and retested.

### 3.06 LEAKAGE TESTING FOR MANHOLES

- A. After completion of manhole construction, wall sealing, or rehabilitation, test manholes for water tightness using hydrostatic or vacuum testing procedures.
  1. New Manhole Construction: Conduct test prior to backfilling.

- B. Plug influent and effluent lines connected to manhole with suitably-sized pneumatic or mechanical plugs.
1. Utilize plugs that are properly rated for pressures required for test.
  2. Place plugs a minimum of 6 inches outside of manhole walls.
  3. When pipes connected to the manhole have not been backfilled, brace pipes to prevent dislodging from the manhole.

C. Vacuum Testing:

1. Install vacuum tester head assembly at top access point of manhole and adjust for proper seal on straight top section of manhole structure. Following manufacturer's instructions and safety precautions, inflate sealing element to the recommended maximum inflation pressure; do not over-inflate.
2. Evacuate manhole with vacuum pump to 10" mercury (Hg), disconnect pump, and monitor vacuum for the time period specified in the following table.

Depth in Feet	Time in Seconds by Manhole Diameter		
	48"	60"	72"
4	10	13	16
8	20	36	32
12	30	39	48
16	40	52	64
20	50	65	80
24	60	78	96
(a)	5	6.5	8.0
(a) Add times for each additional 2-feet of manhole depth. (The values listed above have been extrapolated from ASTM C924-85).			

3. If the drop in vacuum exceeds 1" Hg over the specified time period tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test procedure until satisfactory results are obtained.

D. Hydrostatic testing:

1. Fill manhole with water to top of frame. Add water over a 24-hour period to compensate for absorption and evaporation losses. After 24 hours, refill to top of frame and observe for loss of water. If, after a 4-hour period the water level is reduced by more than 1/4", the leakage shall be considered excessive. Contractor shall make necessary repairs and retest the manhole.
2. If water loss exceeds amount tabulated above, locate leaks, complete repairs necessary to seal manhole and repeat test produce until satisfactory results are obtained.

**END OF SECTION**



**SECTION 15996**  
**TESTING PRESSURE PIPING**

**PART 1 - GENERAL**

**1.01 SECTION INCLUDES**

- A. Hydrostatic pressure pipeline testing.

**1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section:
  - 1. Section 01330 – Submittals
  - 2. Section 01500 – Construction Facilities and Utilities
  - 3. Section 01999 – Reference Forms
  - 4. Section 15050 – Piping Systems

**1.03 SUBMITTALS**

- A. Provide Submittal per Section 01330.
- B. Testing Schedule and Notification of Testing: Submit advance written notice of testing activities a minimum of 48 hours prior to conducting piping tests.
- C. Testing Plan: Submit a written plan that identifies the methods for water procurement, conveyance and disposal. Provide copies of written approvals from jurisdictional agencies.
- D. Completed Pipe Test Record Forms, found in Section 01999.

**1.04 TESTING REQUIREMENTS**

- A. Furnish personnel, materials, bulkheads, test plugs, restraints, anchors, temporary connections, pumps, pressure gauges and other equipment needed to perform testing.
- B. Water for Testing
  - 1. Use potable water for pressure testing pipelines. Obtain water from the City.
  - 2. Disposal:
    - a. Obtain approvals from the Oregon Department of Environmental Quality and other regulatory agencies to dispose of water in existing drainage ditches and other surface water features. Pay all costs to convey or transport water to the point of disposal.
    - b. Dispose of water used for testing pipelines in the headworks or as specified by the Owner.
- C. Test only those portions of the pipe that have been installed as part of this Contract.
  - 1. Test new pipe sections prior to making final connection to existing piping.
  - 2. Install test plugs or bulkheads to isolate new piping systems.
  - 3. Unless otherwise indicated, valves may not be used to isolate portions of the piping system for purposes of testing. When testing against a valve is indicated or

approved by the Owner, provide a test plate “pancake” to further isolate the new and existing piping.

- D. Sequence
  - 1. Buried Pressure Piping: Except as otherwise indicated, conduct piping pressure test after trench has been backfilled to subgrade and compacted. Piping may be tested before or after final paving, at Contractor’s option.
  - 2. Encased Piping: Test before encasing pipe in concrete.
- E. Failed Tests: Make necessary corrections or remove defective pipe or defective appurtenances. Repeat pressure test until a successful test is achieved.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.01 GENERAL**

- A. Test pipelines, appurtenances, valves and fittings in the pipeline system.
- B. Where allowable leakage rates are not specifically indicated, no leakage is allowed.
- C. Perform testing operations in the presence of the Engineer.
- D. Prior to pressure testing, clean pipeline of debris, construction materials, dirt and other foreign material within the piping system.
- E. Do not test pipelines until thrust restraint devices have been installed. Where concrete thrust blocks are used, do not begin pressure test until concrete has attained an age of at least 7 days unless otherwise approved by the Owner. Pressure test buried pipe after backfill.
- F. After testing has been completed, drain test water from pipelines and leave in clean condition.

### **3.02 FILLING PIPING SYSTEMS WITH WATER**

- A. Place temporary bulkheads in the pipe at the ends of the test section, and then slowly fill the pipeline with water at a rate which does not cause surges or exceed the rate at which the air can be released through the air valves.
- B. Ascertain that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to, or movement of, the adjacent pipe.
- C. Purge air within the pipeline during the filling operation. Check proper operation of air release valves and air vents during the filling operation to ascertain proper operation and venting of air from the pipeline.
- D. Concrete pipe, cement-mortar lined pipe and other pipe made from water absorbing material:
  - 1. After the filling operation is complete, allow the filled pipeline to stand under a slight pressure for at least 24 hours to allow air to escape from any air pockets within the pipeline and the pipe lining to absorb water.
  - 2. Examine bulkheads, valves and connections for leaks during this period. If leaks are found, make corrections before conducting the pressure test.

### 3.03 PRESSURE TESTING EXPOSED PIPING

#### A. Test exposed piping as follows:

1. Fill section of piping under test with water and raise the system pressure to the test pressure specified in the Piping Schedule in Section 15050 or the Drawings.
2. Visually inspect exposed pipe joints, joints at fittings, valves, hydrants, and other piping appurtenances for leaks.
3. Correct leakage as necessary to eliminate the leakage.
4. Duration of Pressure Test: 2 hours.
5. Leakage Allowances: Zero leakage.
6. Correct any visible leakage by tightening flanges and screwed joints, replacing gaskets or removing defective materials.
7. Repeat test until no leakage is observed.
8. Record results of pressure test on Pipe Test Record form, included in Section 01999.

### 3.04 PRESSURE TESTING BURIED PIPING

#### A. Pressure test buried piping as follows:

1. Fill section of piping under test with water and raise the system pressure to the test pressure specified in the Piping Schedule 15050.
2. Visually inspect exposed pipe joints, joints at fittings, valves, hydrants, and other piping appurtenances for leaks.
3. Correct visible leaks necessary to eliminate the leakage.
4. Duration of Pressure Test: 2 hours.
5. Leakage Measurement:
  - a. Begin test once visible leaks have been eliminated.
  - b. Maintain test pressure during the test period by adding makeup water to a calibrated test reservoir.
  - c. Accurately measure the volume of makeup water introduced into the pipeline to maintain the test pressure to determine the leakage rate for the test.
6. The pipeline pressure test is successful when the makeup water added during the test is equal to or less than the allowable leakage rate (L) defined below.
7. Gasketed Ductile Iron Pipe (mechanical or push-on joint)

$$L = \frac{SD(P)^{1/2}}{148,000}$$

L = Allowable leakage in gallons per hour.

S = Length of the test section in feet.

D = Nominal diameter of the piping in inches.

P = Test pressure in pounds per square inch gauge.

8. Steel Pipe (AWWA C200, Concrete Bar Wrapped Cylinder Pipe (AWWA C303)
  - a. Gasketed joints:
    - 1)  $L = 6.25$  gallons/inch diameter/mile/24 hours
    - 2)  $L =$  allowable makeup water in gallons.
  - b. Welded joints: No leakage allowed.
  - c. Where pipeline consists of a combination of welded and gasketed joints, adjust the formula above by the ratio of the joint types over the test section.
9. Polyvinyl Chloride (PCV) pipe:

$$L = \frac{ND(P)^{1/2}}{7,400}$$

$L$  = Allowable leakage in gallons per hour.

$N$  = Number of joints in the length of pipeline to be tested.

$D$  = Nominal diameter of the piping in inches.

$P$  = Test pressure in pounds per square inch gauge.

**END OF SECTION**

**SECTION 16050**  
**ELECTRICAL WORK**

**PART 1 - GENERAL**

**1.01 SUMMARY**

- A. Provide labor, materials, equipment, and incidentals as indicated on the Drawings, specified, and required to complete the electrical work.
- B. Equipment shall be rated and labeled by the manufacturer for the environmental conditions in which it is installed including the power disconnects, control stations, and wiring systems.
- C. Conduits and circuits within electrical distribution or utilization equipment and cabinets shall be identified and labeled as specified and as shown.
- D. System Overview. Detailed requirements are in individual related specification sections.
  - 1. Demolish electrical equipment as indicated on the Drawings.
  - 2. Install conduit and conductors as indicated on the Drawings.
  - 3. Install equipment, junction boxes, and field instruments as indicated on the Drawings.
  - 4. Modify control panels as indicated on the Drawings.

**1.02 REFERENCED SECTIONS**

- A. The following Sections are references in this Section.
  - 1. Section 01330 – Submittals
  - 2. Section 01780 – Record Drawings
  - 3. Section 01782 – Operations and Maintenance Information

**1.03 COORDINATION**

- A. Review installation procedures, drawings and schedules under other Sections and coordinate with other trades the installation of electrical items that must be installed with or within formwork, walls, partitions, ceilings and panels.
- B. Responsible for the installation of conduits, inserts, and other items to be embedded in the concrete, or built into walls, partitions, ceilings or panels constructed by other contractors.
  - 1. Provide other contractors with detailed plans or sketches of the location of said conduits and other built-in items as may be required.
  - 2. Stay fully informed of the construction where conduits and other built-in items are to be installed.
  - 3. Install conduits and other built-in items in such a manner and within such time periods as will not unnecessarily delay the work of the other contractors.

## 1.04 GENERAL

### A. Interpretation of Drawings:

1. Dimensions shown on the Drawings that are related to equipment are based on the equipment of one manufacturer. Confirm the dimensions of the equipment furnished to the space allocated for that equipment.
2. The Drawings show the principal elements of the electrical Work. They are not intended as detailed working drawings for the electrical Work, but as a complement to the Specifications to clarify the principal features of the electrical systems.
3. It is the intent of the Drawings and Specifications that all equipment and devices, furnished and installed under this Contract, be properly connected and interconnected with other equipment and devices so as to render the installations complete for successful operation, regardless of whether all the connections and interconnections are specifically mentioned in the Specifications or shown on the Drawings.
4. It also is the intent of the Contract Documents that similar products are provided by the same manufacturer for uniformity on the Project.

## 1.05 QUALITY ASSURANCE

### A. Requirements of Regulatory Agencies:

1. Permits: Obtain permits and pay fees required to commence Work and, upon completion of the Work, obtain and deliver to the Engineer a Certificate of Inspection and Approval from the authority having jurisdiction.
2. Codes: Material and equipment shall be installed in accordance with the current standards and recommendations of the National Electrical Code, the National Electrical Safety Code and with local codes which apply. Where discrepancies arise between codes, the most restrictive regulation shall apply.
3. Tests by Independent Regulatory Agencies: Electrical material and equipment shall be new and shall bear the label of the Underwriters' Laboratories, Inc., or other nationally-recognized, independent testing laboratory, wherever standards have been established and label service regularly applies.

### B. Reference Standards: Electrical material and equipment shall conform in all respects to the latest approved standards of the following:

1. 2022 Oregon Structural Specialty Code
2. 2021 Oregon Energy Efficiency Specialty Code
3. 2021 Oregon Electrical Specialty Code
4. 2021 Oregon Mechanical Specialty Code
5. 2021 Oregon Plumbing Specialty Code
6. NFPA 70E Standard for Electrical Safety in the Workplace
7. U.L. Electrical Construction Materials List
8. OSHA Rules and Regulations Codes, rules and regulations as applicable and as specified hereinafter.

9. National Electrical Manufacturers Association (NEMA).
10. The American National Standards Institute (ANSI).
11. The Institute of Electrical and Electronic Engineers (IEEE).
12. Insulated Cable Engineers Association (ICEA).
13. National Electrical Safety Code (NESC).
14. American Society for Testing and Materials International (ASTM).
15. The Instrumentation, Systems and Automation Society (ISA).
16. National Fire Protection Agency (NFPA).
17. Underwriter's Laboratories, Inc. (UL).

#### 1.06 SUBMITTALS

- A. Refer to Section 01330 for submittal requirements.
- B. Include the following information to the extent applicable to the particular item:
  1. Manufacturer's name and product designation or catalog number, including environmental rating such as "Rated for Outdoor Use" or "Rated for Hazardous Location".
  2. Electrical ratings.
  3. Conformance to applicable standards or specifications of ANSI, ASTM, ICEA, IEEE, ISA, NEC, NEMA, NFPA, OSHA, UL, or other organizations.
  4. Dimensioned plan, section, elevations and panel layouts showing means for mounting, conduit connection, and grounding.
  5. Materials and finish specification, including paints.
  6. List of components including manufacturer's names and catalog numbers.
  7. Internal wiring diagram and drawings indicating all connections to components and numbered terminals for external connections.
- C. Substitution: Only one substitution for each type of equipment or material will be considered.

#### 1.07 PROJECT CLOSEOUT

- A. Operation and Maintenance Data: Submit complete manuals including:
  1. Furnish Operation and Maintenance Manuals in accordance with the requirements of Section 01782, including:
    - a. Copies of all Record Drawings and Wiring Diagrams, test reports, maintenance data and schedules, description of operation, and spare parts information.
- B. Record Drawings
  1. Furnish in accordance with the requirements of Section 01780, including:
    - a. System Record Drawings: Include the following:
      - 1) One line wiring diagram of the distribution system.

- 2) Accurate and detailed in place conduit and cable layouts with schedule of conduit sizes and number and size of conductors.
- 3) Layouts of the power and lighting arrangements and the grounding system.
- 4) Control schematic diagrams, with terminal numbers and all control devices identified, for all equipment.
- b. Point-to-Point Interconnection Wiring Diagram Drawings: Include the following:
  - 1) External wiring for each piece of equipment, panel, instrument and other devices and conduit wiring to control stations, lighting panels and motor controllers.
  - 2) Numbered terminal block identification for each wire termination.
  - 3) Identification of the assigned wire numbers for interconnections.
  - 4) Identification of conduit wiring by the conduit tag in which the wire is installed.
  - 5) Terminal and pull boxes through which wiring is routed.
  - 6) Identification of all equipment and the Shop Drawing transmittal numbers for equipment from which the wiring requirements and termination information was obtained.
2. The Record Drawings shall reflect final equipment and field installation information.
3. During the progress of the work, maintain at least one set of up-to-date record drawings which shall be the conformed project drawings with annotations by the Contractor recording all deviations from the plans.

#### 1.08 PRODUCT DELIVERY, STORAGE AND HANDLING

##### A. Delivery and Storage of Materials:

1. Instruct the manufacturers and vendors as to the maximum shipping sizes of equipment that can be accommodated at the site.
2. Make all arrangements for transportation, delivery and handling of equipment and materials required for prosecution and completion of the Work.
3. Shipments of materials to Contractor or subcontractors shall be delivered to the site only during regular working hours and shall conform to the requirements of the Contractor's Hazardous Materials Management Program. Shipments shall be addressed and consigned to the proper party giving name of Project, street number and city. Shipments shall not be delivered to Owner.
4. If necessary to move stored materials and equipment during construction, move materials and equipment without any additional compensation.
5. When practical, factory assemble products. Matchmark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with a strippable protective coating.
6. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or label outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, Owner's



contract name and number, Contractor, equipment number, and approximate weight. Include complete packing lists and bills of materials with each shipment.

7. Protect products from exposure to the elements and keep thoroughly dry and dust free at all times. Protect painted surfaces against impact, abrasion, discoloration, or other damage. Grease or oil all bearings and similar items.
8. Do not have products shipped until:
  - a. Related Shop Drawings have been approved by Engineer.
  - b. Related factory test results, required in the individual Specification Sections, have been reviewed and accepted by Engineer.
  - c. Required storage facilities have been provided.
9. Items shall be supported, packaged and stored in such a way so as not to impose undue stress/forces to couplings, connections, supports, valves, equipment and instruments.
10. Arrange deliveries of products in accordance with construction schedules and in ample time to facilitate inspection prior to installation.
11. Coordinate deliveries to avoid conflict with Work and conditions on site and to accommodate the following:
  - a. Work of other contractors, or Owner.
  - b. Limitations of storage space.
  - c. Availability of equipment and personnel for handling products.
  - d. Owner's use of premises.
12. Immediately on delivery, inspect shipment to assure:
  - a. Product complies with requirements of Contract Documents and approved submittal.
  - b. Quantities are correct.
  - c. Containers and packages are intact, and labels are legible.
  - d. Products are properly protected and undamaged.
  - e. Verify that the accelerometer recordings were made during shipment.
13. Promptly remove damaged products from the Project site and expedite delivery of new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

**B. Handling of Materials:**

1. Provide equipment and personnel necessary to handle products, including those provided by Owner, by methods to prevent soiling or damage to products or packaging.
2. Provide additional protection during handling as necessary to prevent scraping, marring or otherwise damaging products or surrounding surfaces.
3. Handle products by methods to prevent bending or oversteering.
4. Lift heavy components only at designated lifting points.
5. Materials and equipment shall at all times be handled in a safe manner and as recommended by manufacturer or supplier so that no damage will occur to them.

Do not drop, roll or skid products off delivery vehicles. Hand carry or use suitable materials handling equipment.

#### 1.09 JOB CONDITIONS

A. Existing Conditions:

1. Examine the site and existing facilities in order to compare them with the Contract Documents with respect to the conditions of the premises, location of and connection to existing facilities and any obstructions which may be encountered.
2. Perform the Work with due regard to safety and in a manner that will not interfere with the existing equipment or in any way cause interruption of any of the functions of the plant.
3. Work shall be carried out with a minimum amount of disruption to the operation of the existing plant and with prior approval of Owner. Submit for approval by Owner, a detailed written procedure for work which affects operation of the existing plant, a detailed procedure for modifying any existing electrical equipment, including appropriate Personal Protective Equipment (PPE) required if equipment must remain energized while conducting work, anticipated time required to complete the Work, and the required shutdown time, if any.
4. Where the Work of Contractor ties in with existing installations, take prior precautions and safeguards in connecting the Work with the existing operating circuits so as to prevent any interruption to the existing operating circuits. The tying in of Work, installed under this Contract, with the existing circuits shall be performed only in the presence of Owner. Advance notice will be required before any equipment is removed from service. Notify Owner, in writing, of his intention to do such work, providing full details.

#### 1.10 CONTROL CABINETS AND PANELS

- A. All outdoor panels, with electronics and temperature sensitive instruments, shall be provided with sunshade structures. Sunshade structures shall be constructed as shown on drawings.
- B. All control cabinet and panel materials shall be as follows, unless otherwise specified or noted on the Drawings.
- C. Provide the following types of enclosures:
1. All indoor locations: (Not Applicable)
  2. All outdoor locations: NEMA 4X - 316 stainless steel.
  3. All explosion proof locations, NEMA 7.
- D. Provide the following enclosure features:
1. UL/NEMA 12 Enclosures: (Not Applicable)
  2. UL/NEMA 4X Enclosures:
    - a. Provide enclosures with Type 316 stainless steel construction. Wall or floor mounted enclosures fabricate using a minimum 14 gage steel. Free standing enclosures fabricate using a minimum 12 gage steel. Enclosures smaller than 14"x 12"x 6" fabricate using a minimum of 16 gage steel.

- Keep steel free of pitting and surface blemishes. Provide all surfaces with a smooth brushed finish.
- b. Provide stainless steel fast-operating clamp assemblies on three sides of each door.
- c. Rolled lip around three sides of door and along top of enclosure opening.
- d. Provide a hasp and staple for padlocking.
- e. Provide 3-inch high channel base assembly, with solid bottom, drilled to mate the panel to its floor pad for free-standing panel.
- f. Provide 5/16-inch diameter copper ground studs for the ground connection points for all panel equipment and panel doors.
- g. Product and Manufacturer: Provide one of the following:
  - 1) Hoffman/Pentair
  - 2) Or equal
- 3. UL/NEMA 7 Enclosures
  - a. House monitoring and measuring devices located in hazardous environments in explosion-proof control enclosures.
  - b. Enclosures rated for use in NEC Class 1, Groups C&D or Class II, Groups E, F & G applications and comply with UL and CSA standards.
  - c. Required Features:
    - 1) Light weight and corrosion resistant copper-free aluminum
    - 2) Integral, cast-on mounting lugs
    - 3) Left side door hinges
    - 4) Viewing windows sized to suit internally mounted components
    - 5) Stainless steel cover bolts
    - 6) Cad-plated steel mounting pans
  - d. Product and Manufacturer: Provide one of the following:
    - 1) Adalet
    - 2) Killark
    - 3) Crouse-Hinds
    - 4) Hoffman

#### 1.11 ELECTRICAL EQUIPMENT

- A. All electrical equipment shall be capable of operating successfully at full-rated load, without failure, with an ambient outside air temperature range of -5°F to 105°F and an elevation of 640 feet (MSL).
- B. All electrical devices and equipment shall have ratings based on 75°C terminations.

#### 1.12 AREA CLASSIFICATIONS

- A. Materials and equipment shall conform to the area classification(s) shown on the Drawings, specified and required.
- B. Wet/Corrosive Locations: The following areas shall be considered wet/corrosive locations:
  - 1. All outdoor areas.

2. All indoor areas below grade, unless otherwise specified.
- C. Hazardous Locations:
  1. Secondary Clarifier No.1: Class 1, Division 2: 18-inches above water level. 18-inch beyond and above basin wall. 18-inch high by 10-feet horizontal boundary beyond basin wall.

#### 1.13 VERIFICATION OF DIMENSIONS

- A. All scaled and figured dimensions are approximate and are given for estimating purposes only. Before proceeding with the work, carefully check and verify all dimensions and sizes and assume all responsibility for the fitting of materials and equipment to other parts of the equipment and to the structure. Where apparatus and equipment are indicated on the drawings, dimensions are taken from typical equipment of the class indicated. Carefully check drawings to see that the equipment contemplated for installation will fit into the spaces provided.

#### 1.14 SUPERVISION OF ELECTRICAL WORK

- A. Contractor shall personally, or through an authorized and competent representative, constantly supervise the work from beginning to completion and final acceptance. So far as possible, keep same foreman and workmen throughout the project duration. Work shall be subject to inspection and approval by Engineer. Promptly furnish related information when so requested by Engineer.

### **PART 2 - PRODUCTS (NOT USED)**

### **PART 3 - EXECUTION (NOT USED)**

### **END OF SECTION**

## **SECTION 16070**

### **HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Support, anchorage, and attachment components.
- B. Fabricated metal equipment support assemblies.

##### **1.02 REFERENCED SECTIONS**

- A. The following Sections are referenced in this Section
  - 1. Section 03301 – Cast-in-Place Concrete
  - 2. Section 05501 – Anchor Bolts and Anchoring Devices
  - 3. Section 09900 – Coating Systems
  - 4. Section 16130 – Raceways and Boxes for Electrical Systems

##### **1.03 REFERENCE STANDARDS**

- A. American Institute of Steel Construction: Allowable Stress Design (ASD).
- B. NSF/ANSI/3-A SSI 14159-1 - Hygiene Requirements for the Design of Meat and Poultry Processing Equipment.

##### **1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Slotted support systems, hardware, and accessories.
    - b. Clamps.
    - c. Hangers.
    - d. Sockets.
    - e. Eye nuts.
    - f. Fasteners.
    - g. Anchors.
    - h. Saddles.
    - i. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.
  - 3. Rated Capacities: Calculated in accordance with AISC ASD, Section F1 or allowable stress equal to 60 percent of material's yield stress. Professional Engineer certified/stamped load ratings with a recommended safety factor of 2.

- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  - 1. Hangers. Include product data for components.
  - 2. Slotted support systems.
  - 3. Equipment supports.
  - 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated Design Submittal: For hangers and supports for electrical systems.
  - 1. Include design and load calculations and details of hangers.
  - 2. Include design calculations for seismic restraints.

#### 1.05 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Manufacturer's Certificates of Conformance: Certifying products meet or exceed specification requirements.

#### 1.06 QUALITY ASSURANCE

- A. Hygienic Area Certifications: Certification of NSF/ANSI/3-A SSI 14159-1 and material compatibility with 21 CFR 177. Applies to PVC-encased all-thread stainless rod, riser/floor stands, tented and flat slotted support members.

### **PART 2 - PRODUCTS**

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame Rating: Class 1.
  - 2. Self-extinguishing in accordance with ASTM D635.
- C. Structural Performance: Hangers and supports for piping and equipment must withstand the effects of gravity loads and stresses within limits and under conditions indicated in accordance with ASCE/SEI 7.
  - 1. Design supports capable of supporting combined weight of supported electrical systems and system contents.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for electrical system and obtain approval from authorities having jurisdiction.

## 2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Stainless Steel Slotted Support Systems: Preformed stainless-steel channels and angles with minimum 13/32 inch diameter holes at a maximum of 8 inch on center in at least one surface.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Rocket Rack, a unit of Robroy Industries or comparable product by one of the following:
    - a. Eaton (B-line).
    - b. Flex-Strut Inc.
    - c. Gripple Inc.
    - d. G-Strut.
    - e. Haydon Corporation.
    - f. MIRO Industries.
    - g. nVent (CADDY).
    - h. Rocket Rack, a unit Robroy Industries.
    - i. Wesanco, Inc.
  - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 3. Material for Channel, Fittings, and Accessories: Stainless steel, Type 316.
  - 4. Channel Width: 1-5/8 inch.
- B. Hygienic Area, Slotted, Horizontal Support Systems: (Not Applicable)
- C. Hygienic Area, Slotted, Vertical Framing Systems: (Not Applicable)
- D. Steel Slotted Support Systems: (Not Applicable)
- E. Aluminum Slotted Support Systems: (Not Applicable)
- F. Nonmetallic Slotted Support Systems: (Not Applicable)
- G. Conduit and Cable Support Devices: Stainless steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- H. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs must have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body must be made of malleable iron.
- I. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- J. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti, Inc.

- 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
  - 3) MKT Fastening, LLC.
  - 4) Simpson Strong-Tie Co., Inc.
2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
- 1) Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a) Eaton (B-line).
    - b) Empire Tool and Manufacturing Co., Inc.
    - c) Hilti, Inc.
    - d) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - e) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
6. Toggle Bolts: Stainless steel springhead type.
7. Hanger Rods: Threaded steel.

## 2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 05501 for steel shapes and plates.

## PART 3 - EXECUTION

### 3.01 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
  1. NECA NEIS 101
  2. NECA NEIS 102.
  3. NECA NEIS 105.
  4. NECA NEIS 111.
- B. Comply with requirements for raceways and boxes specified in Section 16130.
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERM as required by NFPA 70. Minimum rod size must be 1/4 inch in diameter.



- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  - 1. Secure raceways and cables to these supports with single-bolt conduit clamps.
- E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2 inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

### 3.02 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, EMT, IMC and ERMCM may be supported by openings through structure members, in accordance with NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inch thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inch thick.
  - 6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.03 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 05501 for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

### 3.04 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inch larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03301.
- C. Anchor equipment to concrete base as follows:
  - 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 3. Install anchor bolts in accordance with anchor-bolt manufacturer's written instructions.

### 3.05 PAINTING

- A. Touchup:
  - 1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
    - a. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
  - 2. Comply with requirements in Section 09900 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

### **END OF SECTION**

**SECTION 16122**  
**600 VOLT CABLE**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Building wire and cable; and wiring connectors and connections.

1.02 REFERENCED SECTIONS

- A. Section 01330 – Submittals
- B. Section 16050 – Electrical Work
- C. Section 16195 – Identification for Electrical Systems

1.03 REFERENCES

- A. International Electrical Testing Association:
  - 1. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
  - 1. NFPA 70 - National Electrical Code.
  - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
  - 1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.04 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
  - 1. Stranded conductors are required for all feeders and branch circuits.
  - 2. Stranded conductors are required for control circuits.
  - 3. Conductors shall not be smaller than 12 AWG for power and lighting circuits.
  - 4. Conductor shall not be smaller than 14 AWG for control circuits.
- B. Wiring Methods: Provide the following wiring methods:
  - 1. Dry Interior Locations: Use only building wire, Type XHHW-2 insulation in raceway.
  - 2. Wet or Damp Interior Locations: Use only building wire, Type XHHW-2 insulation, in raceway.
  - 3. Exterior Locations: Use only building wire, Type XHHW-2 insulation, in raceway.

1.05 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper.

## 1.06 SUBMITTALS

- A. Refer to Section 01330 for submittal requirements.
- B. Product Data: Submit cutsheets and manufacturer data for all conductor sizes and types proposed for use on this project.
- C. Test Reports: Indicate procedures and values obtained.

## 1.07 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and circuits.

## 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 16050 for requirements related to transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

## 1.09 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

## 1.10 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

## 1.11 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

## 1.12 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned.

# PART 2 - PRODUCTS

## 2.01 BUILDING WIRE

- A. Manufacturers:
  - 1. Aetna Insulated Wire, Inc.
  - 2. Cerro Wire LLC.
  - 3. Encore Wire Corporation.
  - 4. General Cable; Prysmian Group North America.

- 5. Southwire Company.
- B. Substitutions: Or equal.
- C. Product Description: Single conductor insulated wire.
- D. Conductor: Copper.
- E. Insulation Voltage Rating: 600 volts.
- F. Insulation Temperature Rating: 90°C.
- G. Insulation Material: Thermoplastic/Thermosetting.

## 2.02 WIRING CONNECTORS

- A. Split Bolt Connectors:
  - 1. Manufacturers:
    - a. ABB, Electrification Business.
    - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. ILSCO.
  - 2. Substitutions: Or equal.
- B. Solderless Pressure Connectors:
  - 1. Manufacturers:
    - a. 3M.
    - b. Ideal Industries, Inc.
  - 2. Substitutions: Or equal.
- C. Spring Wire Connectors: (NOT PERMITTED)
- D. Compression Connectors:
  - 1. Manufacturers:
    - a. ABB, Electrification Business.
    - b. Burndy; brand of Hubbell Electrical Solutions; Hubbell Incorporated.
    - c. Ideal Industries, Inc.
    - d. Leviton Manufacturing Co., Inc.
  - 2. Substitutions: Or equal.

## 2.03 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.

- C. Verify raceway installation is complete and supported.

### 3.02 PREPARATION

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

### 3.03 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods compatible with existing electrical installations, or as specified, whichever is the more stringent requirement.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

### 3.04 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable under provisions of Section 16195. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
  - 1. Pull conductors into raceway at same time.
  - 2. Install conductors 4 AWG and larger with pulling equipment.
- E. Special Techniques - Wiring Connections:
  - 1. Clean conductor surfaces before installing lugs and connectors.
  - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
  - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
  - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
  - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- F. Install stranded conductors for all branch circuits. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- G. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.

- H. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- I. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

### 3.05 WIRE COLOR

- A. General:
  - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
    - a. Black and red for single phase circuits at 120/240 volts.
    - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
    - c. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.
  - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
    - a. Black and red for single phase circuits at 120/240 volts.
    - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
    - c. Brown, orange, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
  - 1. For 6 AWG and smaller: Green.
  - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

### 3.06 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

## END OF SECTION

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**SECTION 16130**  
**RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Metal conduits and fittings.
- B. Nonmetallic conduits and fittings.
- C. Metal wireways and auxiliary gutters.
- D. Nonmetal wireways and auxiliary gutters.
- E. Surface raceways.
- F. Boxes, enclosures, and cabinets.
- G. Handholes and boxes for exterior underground cabling.

1.02 REFERENCED SECTIONS:

- A. Section 01330 – Submittals
- B. Section 16050 – Electrical Work.
- C. Section 16070 – Hangers and Supports for Electrical Systems

1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

- A. Refer to Section 01330 for submittal requirements.
- B. Product Data: Submit for the following:
  - 1. Metallic conduit.
  - 2. Liquidtight flexible metal conduit.
  - 3. Raceway fittings.
  - 4. Conduit bodies.
  - 5. Outlet boxes.
  - 6. Pull and junction boxes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

## 1.05 ENVIRONMENTAL REQUIREMENTS

- A. Refer to Specification Section 16050 for environmental conditions affecting products on site.

## PART 2 - PRODUCTS

### 2.01 METAL CONDUITS AND FITTINGS

#### A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC Conduit, Elbows, Couplings, and Nipples: (NOT PERMITTED)
3. ARC: (NOT PERMITTED)
4. IMC: (NOT PERMITTED)
5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - a. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:
    - 1) Korkap.
    - 2) Perma-Cote.
    - 3) Plasti-Bond.
    - 4) Substitutions: Or equal.
  - b. Comply with ANSI C80.1, ETL PVC-001, NEMA RN 1, and UL 6.
  - c. Coating Thickness: 0.040 inch, minimum.
  - d. A "PVC Coated Sealing Locknut" shall be used on all exposed male threads transitioning into female NPT threads which do not have sealing sleeves, including transitions from PVC couplings/female adapters to PVC coated GRC elbows in direct burial applications. "PVC Coated Sealing Locknuts" are not to be used in place of a conduit hub.
6. EMT: (NOT PERMITTED)
7. FMC: (NOT PERMITTED)

#### B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crouse Hinds by EATON.
  - b. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - c. Patriot Aluminum Products, LLC.
  - d. Picoma Industries, Inc.
  - e. Thomas & Betts Corporation; A Member of the ABB Group.
2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.

5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.
8. PVC-Coated Fittings:
  - a. Basis-of-Design Product: Subject to compliance with requirements, provide products by one of the following:
    - 1) Korkap.
    - 2) Perma-Cote.
    - 3) Plasti-Bond.
  - b. Fittings shall be Form 8 with a V-Seal tongue-in-groove gasket and supplied with plastic encapsulated stainless steel cover screws. Form 8 fittings shall be UL Type 4X listed and IEC IP69 certified. Fittings shall be from the same manufacturer as the conduit in order to maintain system continuity and warranty. PVC Coated fittings for hazardous locations must be UL 1203 listed.
- C. Joint Compound for PVC coated GRS: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.02 BOXES, ENCLOSURES, AND CABINETS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide boxes, enclosures, and cabinets, by one of the following:
  1. Attabox
  2. Crouse-Hinds, an Eaton business.
  3. EGS/Appleton Electric.
  4. Erickson Electrical Equipment Company.
  5. FSR Inc.
  6. Hoffman; a brand of Pentair Equipment Protection.
  7. Hubbell Incorporated.
  8. Hubbell Incorporated; Wiring Device-Kellems.
  9. Kraloy.
  10. Milbank Manufacturing Co.
  11. MonoSystems, Inc.
  12. Oldcastle Enclosure Solutions.
  13. O-Z/Gedney; a brand of Emerson Industrial Automation.
  14. Plasti-Bond.

15. RACO; Hubbell.
  16. Spring City Electrical Manufacturing Company.
  17. Stahlin Non-Metallic Enclosures.
  18. Thomas & Betts Corporation; A Member of the ABB Group.
  19. Topaz Electric; a division of Topaz Lighting Corp.
  20. Wiremold / Legrand.
  21. Substitutions: Or equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
  - C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
  - D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
  - E. Metal Floor Boxes: (Not Applicable)
  - F. Nonmetallic Floor Boxes: (Not Applicable)
  - G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
  - H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum, galvanized, cast iron with gasketed cover.
  - I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  - J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep, 4 inches by 2-1/8 inches by 2-1/8 inches deep.
  - K. Gangable boxes are prohibited.
  - L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 12, Type 3R, Type 4X (as indicated on the Drawings or elsewhere in Division 16) with continuous-hinge cover with flush latch unless otherwise indicated.
    1. Type 4X Metal Enclosures: 316 Stainless Steel.
  - M. Enclosures rated for use in NEC Class 1, Groups C&D or Class II, Groups E, F & G applications and comply with UL and CSA standards. Refer to Section 16050 for additional requirements.

## **PART 3 - EXECUTION**

### **3.01 RACEWAY APPLICATION**

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
  1. Exposed Conduit: PVC coated rigid steel.
  2. Concealed Conduit, Aboveground: (Not applicable)
  3. Underground Conduit: Schedule 40 PVC conduit or PVC coated rigid steel.
  4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R, or Type 4X as indicated elsewhere.
- B. Indoors: (Not Applicable)
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  1. GRC: (Not Applicable)
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes with PVC touch-up compound after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer. All installers shall be certified by the manufacturer and be able to present a valid unexpired installer certification card prior to installation beginning.

### 3.02 INSTALLATION

- A. Comply with requirements in Section 16070 for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Raceways Embedded in Slabs: (Not Applicable)
- M. Stub-Ups to Above Recessed Ceilings: (Not Applicable)
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35-mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Conduit extending from interior to exterior of building.
  - 4. Conduit extending into pressurized duct and equipment.
  - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
  - 6. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors. Use LFMC in damp or wet locations.
- Z. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to bottom of box unless otherwise indicated.
- AA. Locate boxes so that cover or plate will not span different building finishes.

- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### 3.03 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

**END OF SECTION**

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## **SECTION 16132**

### **FLEXIBLE CONDUITS**

#### **PART 1 - GENERAL**

##### **1.01 DESCRIPTION**

- A. Provide labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install flexible metallic conduit and fittings.

##### **1.02 RELATED SECTIONS:**

- A. Section 01330 – Submittals
- B. Section 16050 – Electrical Work.

##### **1.03 QUALITY ASSURANCE**

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
  - 1. UL Standard No. 360, Liquid-Tight Flexible Steel Conduit.

##### **1.04 SUBMITTALS**

- A. Refer to Section 01330 for submittal requirements.
- B. Shop Drawings: Submit the following for approval:
  - 1. Manufacturer's catalog cuts and technical information for flexible conduit and fittings proposed for use.

##### **1.05 ENVIRONMENTAL REQUIREMENTS**

- A. Refer to Specification Section 16050 for environmental conditions affecting products on site.

#### **PART 2 - PRODUCTS**

##### **2.01 MATERIALS**

- A. Flexible Conduit (Non-hazardous Areas):
  - 1. Material: Flexible galvanized steel core with smooth, abrasion resistant, liquid-tight, polyvinyl chloride cover and color to be black. Continuous copper ground built in for sizes 3/4-inch through 1-1/4-inch. Material shall be UL listed.
  - 2. Product and Manufacturer: Provide one of the following:
    - a. Sealtite UA by Anaconda Metal Hose Division, Anaconda American Brass Company.
    - b. Liqueflex Type L.A. by Electric-Flex Company.
    - c. Or equal.

- B. Flexible Conduit (Class 1, Group D, Division 1, Hazardous Areas):
  - 1. Material: Flexible brass inner core with bronze outer braid. Steel, brass or bronze end fittings. Minimum of 12-inches in length.
  - 2. Product and Manufacturer: Provide one of the following:
    - a. Type ECGJH or ECLK by Crouse Hinds Company.
    - b. Type EXGJH or EXLK by Appleton Electric Company.
    - c. Or equal.
- C. Flexible Conduit Fittings:
  - 1. Material and Construction: Malleable iron with zinc electroplating finish. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size and shall be UL listed.
  - 2. Product and Manufacturer: Provide one of the following:
    - a. Crouse-Hinds Company.
    - b. Appleton Electric Company.
    - c. Or equal.
- D. PVC Coated Conduit Fittings:
  - 1. Material and Construction: Malleable iron with standard finish and 40-mil PVC exterior coating. Fittings shall adapt the conduit to standard threaded connections, shall have an inside diameter not less than that of the corresponding standard conduit size.
  - 2. Use: Provide on flexible conduit in areas designated as corrosive locations.
  - 3. Product and Manufacturer: Provide one of the following:
    - a. Robroy Industries.
    - b. Permacote Industries.
    - c. OCAL Incorporated.
    - d. Or equal.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION**

- A. Install at motors, transformers and equipment which are subject to vibration or require movement for maintenance purposes. Provide necessary reducer where equipment furnished cannot accept 3/4-inch size flexible conduit. Limit flexible conduit length to three feet maximum.

### **END OF SECTION**

**SECTION 16133**  
**SEALING FITTINGS**

**PART 1 - GENERAL**

1.01 DESCRIPTION

- A. Provide labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install conduit sealing fittings.

1.02 REFERENCED SECTIONS:

- A. Section 01330 – Submittals
- B. Section 16050 – Electrical Work.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
  - 1. UL Standard 886, Electrical Outlet Boxes and Fittings for Use in Hazardous Locations, Class 1, Groups A, B, C and D and Class II, Groups E, F and G.

1.04 SUBMITTALS

- A. Refer to Section 01330 for submittal requirements.
- B. Shop Drawings: Submit for approval the following:
  - 1. Manufacturer's catalog cuts and technical information for conduit sealing fittings proposed for use.
  - 2. Listing of locations where fittings are to be used.

1.05 ENVIRONMENTAL REQUIREMENTS

- A. Refer to Specification Section 16050 for environmental conditions affecting products on site.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Materials and Construction:
  - 1. Cast gray iron alloy or cast malleable iron or copper free aluminum bodies with zinc electroplate and lacquer or enamel finish.
  - 2. Ample opening with threaded closure for access to conduit hub for making dam.
  - 3. In corrosive locations, fittings shall include a factory applied 40-mil PVC coating.
- B. Sealing fiber for forming the dam within the hub and the sealing compound shall be approved for use with the fittings furnished, and shall be products of the fitting manufacturer.

C. Product and Manufacturer: Provide one of the following:

1. Appleton Electric Company.
2. Eaton/Crouse Hinds Company.
3. Or equal.

### **PART 3 - EXECUTION**

#### **3.01 INSTALLATION**

- A. Install for hazardous locations as required by National Electrical Code, and as indicated on the Drawings.
- B. Select a fitting for the proper use in respect to the mounting position.
- C. Use oversized fittings with reducing bushings when necessary to maintain cable fill requirements of the conduit system.

**END OF SECTION**

## **SECTION 16136**

### **OUTLET BOXES**

#### **PART 1 - GENERAL**

##### **1.01 SUMMARY**

- A. Provide labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install outlet boxes for mounting wiring devices (outlets and snap switches) and lighting fixtures.

##### **1.02 REFERENCED SECTIONS:**

- A. Section 16050 – Electrical Work
- B. Section 16122 – 600 Volt Cable
- C. Section 16140 – Wiring Devices

##### **1.03 REFERENCES**

- A. National Fire Protection Association:
  - 1. NFPA 70, National Electrical Code.
- B. National Electrical Manufacturers Association:
  - 1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
  - 2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  - 3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
  - 4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
- C. Underwriters Laboratories
  - 1. UL Standard No. 50, Electrical Cabinets and Boxes.
  - 2. UL Standard No. 886, Electrical Outlet Boxes and Fittings for Use in Hazardous Locations.

##### **1.04 SYSTEM DESCRIPTION**

- A. Boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Boxes are shown in approximate locations unless dimensioned.
- B. Outdoor Locations, Above Grade: Provide cast FD PVC Coated outlet boxes with cast threaded hubs, NEMA 4X stainless steel pull, and junction boxes, appropriate for the environmental conditions.
- C. In Slab Above Grade: Provide cast PVC Coated outlet boxes with threaded hubs, appropriate for the environmental conditions.

- D. Wet and Damp Locations: Provide PVC coated rigid steel conduit. Provide cast FD PVC Coated outlet boxes with cast threaded hubs, NEMA 4X stainless steel pull, and junction boxes, appropriate for the environmental conditions.

#### 1.05 SUBMITTALS

- A. Shop Drawings: Submit for approval the following:
  - 1. Manufacturers technical information for outlet boxes proposed for use.
- B. Closeout submittals
  - 1. Project Record Documents:
    - a. Record actual locations and mounting heights of outlet boxes.

#### 1.06 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:
  - 1. NEC Article 314, Outlet, Switch and Junction Boxes and Fittings.
  - 2. UL Standard No. 514, Electrical Outlet Boxes and Fittings.

#### 1.07 DELIVERY, STORAGE AND PROTECTION

- A. Refer to Specification Section 16050.
- B. Protect materials from weather, construction traffic, dirt water, chemical and mechanical damage.

### **PART 2 - PRODUCTS**

#### 2.01 MATERIALS

- A. Device Boxes:
  - 1. Material: Cast gray iron alloy, or cast malleable iron, with zinc electroplate finish in wet locations and zinc-coated sheet steel in dusty locations. Cast boxes shall be hub type and include external mounting lugs. In corrosive locations, boxes shall include a factory applied 40-mil PVC coating. In dusty locations, where conduit is installed concealed, boxes shall be steel galvanized and shall include suitable extension rings and covers, as required.
  - 2. Device Cover Plates:
    - a. Gasketed spring door type for wet and corrosive locations. Plates in corrosive locations shall include a factory applied 40-mil PVC coating.
    - b. Integral with device for hazardous locations.
    - c. Stainless steel screws and hardware.
  - 3. Manufacturer: Provide device boxes of one of the following:
    - a. Appleton Electric Company.
    - b. Crouse-Hinds Company.
    - c. Substitutions: Approved equal.

## 2.02 SOURCE QUALITY CONTROL

- A. Material and equipment shall be listed or recognized by Underwriters Laboratories Inc. (UL) for the use intended.
- B. The Owner and Construction Manager require the specified manufacturer to provide the equipment and/or products to be furnished under this section. The Owner and Construction Manager believe the manufacturer is capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed to mean that the named manufacturer's standard product will comply with the requirements of this Section. Manufacturers shall be as specified for the purpose of compatible and efficient utilization of existing equipment, supplies, and personnel training and experience.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- B. Carefully select box locations so that the equipment or piping of other trades passing under, over, across or in close proximity to same, will not limit access for use or maintenance. If the Contractor is unsure about the final location of any box, consult with the Engineer for decision.
- C. Mounting Heights:
  - 1. The exact mounting height of each switch, receptacle, light fixture outlet, etc., shall be confirmed on the premises in conference with the Engineer.
  - 2. Unless otherwise indicated, receptacles to be mounted at 42-inches above clarifier walkway deck.
- D. Install and orient boxes to accommodate wiring devices as specified in Section 16140.
- E. Fasten boxes rigidly and neatly to supporting structures.
- F. Leave no open conduit holes in boxes. Close unused openings with capped bushings.
- G. Label each circuit in boxes and identify in accordance with Section 16122.
- H. Install in conformance with National Electrical Code.

### END OF SECTION

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**SECTION 16140**  
**WIRING DEVICES**

**PART 1 - GENERAL**

1.01 SCOPE

- A. Provide labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install receptacles, wall snap switches and device plates.

1.02 REFERENCED SECTIONS:

- A. Section 16122 – 600 Volt Cable
- B. Section 16136 – Outlet Boxes.

1.03 QUALITY ASSURANCE

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified.
- B. National Fire Protection Association:
  - 1. NFPA 70, National Electrical Code.
- C. Underwriters Laboratory
  - 1. UL Standard No. 1010, Electrical Receptacle - Plug Combinations for Use in Hazardous Locations.
  - 2. UL Standard No. 20, General Use Snap Switches.
  - 3. UL Standard No. 894, Switches for Use in Hazardous Locations.
- D. National Electrical Manufacturers Association:
  - 1. NEMA WD 1 - General Requirements for Wiring Devices.
  - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.04 SUBMITTALS

- A. Shop Drawings: Submit the following for approval:
- B. Manufacturer's technical information for receptacles, switches and device plates proposed for use.

**PART 2 - PRODUCTS**

2.01 MATERIALS

- A. Receptacles for Non-Hazardous Locations: (Not Used)
- B. Receptacles for Hazardous Locations: (Not Used)
- C. Ground Fault Receptacles:
  - 1. Duplex receptacle, two pole, three wire, 125 volt AC, 20 amperes.

2. Product and Manufacturer: Provide one of the following:
  - a. Catalog No. GFR5362ITR, by Hubbell Inc.
  - b. Substitutions: Approved equal.
- D. Surge Suppression Receptacles: (Not Used)
- E. Power Receptacles: (Not Used)
- F. Power and Special Receptacles: (Not Used)
- G. Switches for Non-Hazardous Locations: (Not Used)
- H. Switches for Hazardous Locations: (Not Used)
- I. Switch Covers: (Not Used)
- J. Key Operated On-Off Switches: (Not Used)
- K. Wiring Device Coverplates:
  1. Indoor Coverplates: (Not Used)
  2. Weatherproof locations:
    - a. Wiring devices installed outdoors or where identified on Drawings with “WP” shall contain a gasketed coverplate UL approved for wet locations.
  3. Where weatherproof-while-in-use coverplates are indicated on the Drawings or required by NEC, provide power receptacles with a cover that maintains UL approval for wet locations when a cord is plugged into the receptacle. Weatherproof-while-in-use coverplates shall be TayMac 10130 or equal.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

#### **3.02 PREPARATION**

- A. Clean debris from outlet boxes.

#### **3.03 EXISTING WORK**

- A. Disconnect and remove abandoned wiring devices.
- B. Modify installation to maintain access to existing wiring devices to remain active.
- C. Clean and repair existing wiring devices to remain or to be reinstalled.

#### **3.04 FIELD QUALITY CONTROL**

- A. Damaged or painted devices shall be replaced or cleaned as directed by the Engineer.

### 3.05 INSTALLATION

- A. Install receptacles and switches at locations as shown on the Drawings in outlet or device boxes in accordance with Section 16136, in non-hazardous locations.
- B. Install receptacles and switches in PVC coated galvanized rigid steel conduit systems in hazardous locations, or as indicated on the Drawings.
- C. Install receptacles with ground pole in the down position.
- D. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- E. Install plates on all switch and blank outlets.
- F. Mount receptacles 42-inches above walkway deck in non-hazardous locations and 4 feet-6 inches above finished floor in hazardous locations, unless otherwise noted.
- G. Identify each conductor with the circuit number and the lighting panel number. Identification shall conform to the requirements of Section 16122.
- H. Devices and coverplates shall be plumb and parallel to adjacent surfaces or trim.
- I. Receptacles identified as GFCI or when required by the NEC shall have individual GFCI receptacles installed for each outlet. Installing a single GFCI receptacle and standard receptacles connected to the load side of the single GFCI receptacle is unacceptable.
- J. Identify each receptacle with a permanent self-adhesive label. Approximate size 3/8" x 1-1/4". The label shall include the panel name and circuit number.
  - 1. Product and Manufacturer: Provide one of the following:
    - a. Catalog No. PTL-45422 by Brady.
    - b. Substitutions: Approved equal.
- K. Install in conformance with National Electrical Code.

### **END OF SECTION**

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## **SECTION 16195**

### **IDENTIFICATION FOR ELECTRICAL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Nameplates.
- B. Wire markers.
- C. Conduit markers.

##### **1.02 REFERENCED SECTIONS**

- A. Section 01330 – Submittals
- B. Section 16050 – Electrical Work

##### **1.03 SUBMITTALS**

- A. Refer to Section 01330 for submittal requirements.
- B. Product Data:
  - 1. Submit manufacturer's catalog literature for each product required.
  - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function. Identification for AC powered equipment to include voltage and power source.
- C. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- D. Closeout Submittals
  - 1. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

##### **1.04 QUALITY ASSURANCE**

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this Section.

##### **1.05 DELIVERY, STORAGE, AND HANDLING**

- A. Refer to Specification Section 16050, for requirements related to transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

## 1.06 ENVIRONMENTAL REQUIREMENTS

- A. Refer to Specification Section 16050 for environmental conditions affecting products on site.

## PART 2 - PRODUCTS

### 2.01 NAMEPLATES

- A. Manufacturers:
  - 1. Craftmark Pipe Markers.
  - 2. Kolbi Pipe Marker Co.
  - 3. Pipemarker.com; Brimar Industries, Inc.
  - 4. Seton Identification Products; a Brady Corporation company.
  - 5. Substitutions: Or equal.
- B. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- C. Letter Size:
  - 1. 3/16 inch high letters for identifying individual equipment and loads.
  - 2. 1/4 inch high letters for identifying grouped equipment and loads.
- D. Minimum nameplate thickness: 1/8 inch.

### 2.02 WIRE MARKERS

- A. Manufacturers:
  - 1. Brady ID.
  - 2. Grafoplast Wire Markers.
  - 3. Ideal Industries, Inc.
  - 4. Substitutions: Or equal.
- B. Description: Brady PSPT perma-sleeve heat shrinkable white polyolefin (B-342) labels, for conductor sizes 28 AWG to 500 KCMIL.
- C. Legend:
  - 1. Power and Lighting Circuits: Branch circuit or feeder number.
  - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.

### 2.03 CONDUIT AND RACEWAY MARKERS

- A. Manufacturers:
  - 1. Seton Identification Products; a Brady Corporation company.
  - 2. Substitutions: Or equal.
- B. Description: Brass Tags - Raceway Markers
  - 1. Material: 1.5 inch circular brass tags stamped with 3/16 inch high characters.

2. Lettering: Stamped with 3/16 inch high characters.
3. Stainless Steel Tie: Attached with cleanly cut 48 mil stainless steel wire secured and or spliced with an irreversible style crimp.
4. Tie Installation Tool: Proper tool approved for the purpose.

## **PART 3 - EXECUTION**

### **3.01 PREPARATION**

- A. Degrease and clean surfaces to receive adhesive for identification materials.

### **3.02 EXISTING WORK**

- A. Install identification on existing equipment to remain in accordance with this Section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates, labels, and markers.

### **3.03 INSTALLATION**

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
  1. Install nameplate parallel to equipment lines.
  2. Install nameplate for each electrical distribution and control equipment enclosure with stainless steel screws.
  3. Install nameplates for each control panel and major control components located outside panel with stainless steel screws.
  4. Install left to right, top to bottom.
  5. Secure nameplate to equipment front using stainless steel screws.
  6. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
  7. Install nameplates for the following:
    - a. Control panels.
    - b. Instruments and controls.
    - c. Other electrical equipment where shown on the drawings or specified.
- C. Wire Marker Installation:
  1. Install wire marker for each conductor at each connection.
  2. Installation of wire markers shall be consistent in installation and installed so they read top to bottom for vertically terminated wires and read left to right for horizontally terminated wires.
  3. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
  4. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.

D. Conduit or Raceway Marker Installation:

1. Install marker for each conduit or raceway longer than 6 feet.
2. Conduit or Raceway Marker Spacing: Locations: All terminations.
3. All tags shall be clearly legible or will otherwise be rejected.
4. All shall be identified on both ends using a to/from system that identifies the origination or destination of the conduit and will stay consistent throughout the project. The identification tag will contain the job specific tag and or identifier for the equipment at which that conduit ends. If in question, the owner will determine the information to be provided on the tag.
5. Tagging will be accomplished by use of the following methods, 1.5 inch circular brass tags stamped with 3/16 inch high characters and attached with cleanly cut 48 mil stainless steel wire secured and or spliced with an irreversible style crimp using the proper tools approved for the purpose.

**END OF SECTION**



**SECTION 16411**  
**DISCONNECT SWITCHES**

**PART 1 - GENERAL**

**1.01 DESCRIPTION**

- A. Provide labor, materials, equipment and incidentals as shown on the Drawings, specified and required to furnish and install disconnect switches.

**1.02 REFERENCED SECTIONS**

- A. Section 16070 – Hangers and Supports for Electrical Systems
- B. Section 16195 – Identification for Electrical Systems

**1.03 QUALITY ASSURANCE**

- A. Reference Standards: Comply with applicable provisions and recommendations of the following, except where otherwise shown or specified:
- B. International Electrical Testing Association:
  - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Electrical Manufacturers Association:
  - 1. NEMA KS-1, Enclosed Switches.
  - 2. NEMA 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
- D. National Fire Protection Association:
  - 1. NFPA 70, National Electrical Code.
- E. Underwriters Laboratory
  - 1. UL Standard No. 98, Enclosed Switches.

**1.04 SUBMITTALS**

- A. Shop Drawings: Submit for approval the following:
  - 1. Manufacturer's technical information for disconnect switches proposed for use.
  - 2. Listing of the switches to be furnished with an identification of their location, intended load(s) being served, horsepower and current rating, voltage rating, number of poles and wires, NEMA enclosure type and enclosure dimensions.
  - 3. Closeout Submittals
  - 4. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

**1.05 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

## 1.06 EXTRA MATERIALS

- A. Furnish three spare fuses of each Class, size, and rating installed.

## PART 2 - PRODUCTS

### 2.01 FUSIBLE SWITCH ASSEMBLIES (NOT USED)

### 2.02 NON-FUSIBLE SWITCH ASSEMBLIES

- A. Product Description:
  - 1. NEMA KS 1, Type Heavy Duty (HD) with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch.
  - 2. Handle lockable in OFF position.
- B. Furnish switches with entirely copper current carrying parts.
- C. Enclosure: NEMA 250, to meet conditions:
  - 1. Interior Dry Locations: (Not Used)
  - 2. Exterior Locations: (Not Used)
  - 3. Wet, Damp, Process, Washdown, or Corrosive Locations: Type 4X, 316 stainless steel.
  - 4. Hazardous Areas: Type 7.
- D. Switch Ratings
  - 1. Rating: Voltage and current ratings and number of poles as required for motor or equipment circuits being disconnected. Switches shall bear a UL label.
  - 2. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.
  - 3. Short Circuit Current Rating: UL listed for 10,000 rms symmetrical amperes.
- E. Provide auxiliary dry contacts to indicate switch position.

### 2.03 MATERIALS

- A. Double Throw Safety Switches: (Not Applicable)
- B. Identification:
  - 1. Identify all enclosures in accordance with Section 16195.
  - 2. Nameplate identifying equipment, include identification of the equipment served and source of power, for which switches serve as the disconnecting means. Nameplates shall be permanently fastened to enclosures.

## PART 3 - EXECUTION

### 3.01 EXISTING WORK

- A. Disconnect and remove abandoned enclosed switches.
- B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.

- C. Clean and repair existing enclosed switches to remain or to be reinstalled.

### 3.02 INSTALLATION

- A. Install enclosed switches plumb and level. Provide supports in accordance with Section 16070.
- B. Height: 5 feet to operating handle or as indicated on the Drawings.
- C. Install engraved plastic nameplates in accordance with Section 16195.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.

### 3.04 INSTALLATION

- A. Prior to installing disconnect switches, coordinate with other trades to verify conduits have adequate space to leave and enter the switch enclosure and for required code clearance. A minimum working clearance as defined by the NEC 110-26 shall be provided.
- B. Mount equipment so that sufficient access and working space is provided for ready and safe operation and maintenance.
- C. Securely fasten equipment to walls or other structural supports on which they are mounted. Provide independent stainless steel supports where no wall or other structural surface exists.
- D. Furnish one set of spare fuses for each fused disconnect switch to be installed.
- E. Install in conformance with National Electrical Code.

## **END OF SECTION**

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## **SECTION 16423**

### **MOTOR CONTROL CENTERS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Motor control centers. This project will replace an existing motor control starter bucket in MCC-3 with new.

##### **1.02 REFERENCED SECTIONS**

- A. Section 16195 – Identification for Electrical Systems

##### **1.03 SUBMITTALS**

- A. Product Data: Electrical characteristics including voltage, frame size and trip ratings, fault current withstand ratings, and time-current curves of equipment and components.
- B. Shop Drawings: Indicate front view of the bucket with overall dimensions shown; name-plate legends; electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time and current curves of equipment and components.
- C. Test and Evaluation Reports: Indicate field test and inspection procedures and test results.
- D. Source Quality Control Submittals: Indicate results of factory tests and inspections.

##### **1.04 CLOSEOUT SUBMITTALS**

- A. Project Record Documents:
  - 1. Record actual locations, configurations, and ratings of motor control centers and major components.

##### **1.05 QUALIFICATIONS**

- A. Manufacturer:
  - 1. Company specializing in manufacturing products specified in this Section with three years' experience.

##### **1.06 ENVIRONMENTAL CONDITIONS**

- A. Conform to NEMA ICS 2 service conditions during and after installation of motor control center buckets.

##### **1.07 EXISTING CONDITIONS:**

- A. Verify field measurements prior to fabrication.

#### **PART 2 - PRODUCTS**

##### **2.01 MOTOR CONTROL CENTERS**

- A. Manufacturers:
  - 1. Proposed manufacturer shall match existing MCC manufacturer.

- 2. Substitutions: Not permitted.
- B. Furnish materials according to City of Davis standards.
- C. Description: NEMA ICS 3, Class I, Type B motor control center.
  - 1. Existing Main Overcurrent Protection: Molded case circuit breaker.
  - 2. Feeder Tap Units: Molded case thermal-magnetic circuit breakers.
- D. Operation:
  - 1. Service Conditions: NEMA ICS 2.
    - a. Altitude: 460 feet above sea level.
  - 2. Existing Voltage Rating: 480 volts, three phase, three wire, 60 Hz.
  - 3. Existing Integrated Equipment Short Circuit Rating: 65,000 amperes rms symmetrical at 480 volts.
- E. Fabrication
  - 1. Configuration: Units front mounting only, accessible from front only.
  - 2. Enclosure: NEMA ICS 6, Type 1, gasketed.
- F. Finishes
  - 1. Manufacturer's standard gray enamel.

## 2.02 CONTROLLERS

- A. Full-voltage, Non-reversing Controllers:
  - 1. Manufacturers:
    - a. Proposed FVNR manufacturer shall match existing MCC manufacturer.
    - b. Substitutions: Not permitted.
  - 2. Furnish materials according to City of Cottage Grove standards.
  - 3. Description: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. NEMA Size 0 minimum size.
  - 4. Control Voltage: 120 volts, 60 Hz fed from external source.
  - 5. Overload Relay: NEMA ICS 2; solid-state. Overload relay shall communicate to plant control system via Ethernet IP communication.
  - 6. Auxiliary Contacts: NEMA ICS 2, 2 each normally open and normally closed contacts in addition to seal-in contact.
  - 7. Cover Mounted Pilot Devices: NEMA ICS 5, heavy duty, oiltight type.
  - 8. Pilot Device Contacts: NEMA ICS 5, Form Z, rated A150.
  - 9. Pushbuttons: Unguarded type.
  - 10. Indicating Lights: Transformer, LED type, 30mm.
  - 11. Selector Switches: Rotary type, 30mm.
  - 12. Relays: NEMA ICS 5.

### 2.03 MOLDED CASE CIRCUIT BREAKER

- A. Manufacturers:
  - 1. Proposed breaker manufacturer shall match existing MCC manufacturer.
  - 2. Substitutions: Not permitted.
- B. Furnish materials according to City of Cottage Grove standards.
- C. Description: UL 489, molded-case circuit breaker.

### 2.04 SOURCE QUALITY CONTROL

- A. Shop inspect and perform standard productions tests for each controller according to manufacturer's standards.
- B. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least seven days before inspections and tests are scheduled.

## **PART 3 - EXECUTION**

### 3.01 DEMOLITION

- A. Disconnect and salvage motor control starter bucket to City of Cottage Grove.
- B. Maintain access to existing motor control center and other installations remaining active and requiring access.

### 3.02 INSTALLATION

- A. Install according to NEMA ICS 2.3 and NEMA 7.1.
- B. Select and configure solid-state overload relays in motor controllers to match installed motor characteristics.
- C. Install engraved plastic nameplates according to Section 16195.
- D. Neatly type label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, voltage rating, and phase rating. Place label in clear plastic holder. Indicate method of identifying phase conductors.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect and test according to NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.16.
- C. Inspect and test variable frequency controllers according to NEMA ICS 7.1.

### 3.04 CLEANING

- A. Clean existing motor control centers to remain or are to be reinstalled.

## **END OF SECTION**

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## **SECTION 16450**

### **GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Equipment Grounding:
  - 1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

##### **1.02 REFERENCED SECTIONS**

- A. Section 01330 – Submittals

##### **1.03 SUBMITTALS**

- A. Provide submittals for grounding, components, and accessories per Section 01330.
- B. Product Data:
  - 1. Submit catalog cuts and descriptive literature for approval as specified herein.
  - 2. Sufficient information, clearly presented, shall be included to determine compliance with drawings and specifications.
  - 3. The specific item(s) proposed shall be marked on the catalog cuts.
- C. Test Reports: Submit certified test reports of ground resistance to the Architect/Engineer for approval.

##### **1.04 REFERENCES**

- A. National Fire Protection Association (NFPA) Publications:
  - 1. No. 70, National Electrical Code (NEC)
- B. Underwriters Laboratories, Inc. (UL) Publications:
  - 1. No. 83, Thermoplastic-Insulated Wires
  - 2. No. 44, Rubber-Insulated Wires and Cables
  - 3. No. 46, Electrical Grounding and Bonding Equipment

#### **PART 2 - PRODUCTS**

##### **2.01 GROUNDING WIRES**

- A. Equipment grounding conductors shall be insulated.
- B. Wire size shall not be less than shown on the drawings and not less than required by the NEC.

## **PART 3 - EXECUTION**

### **3.01 INSTALLATION, GENERALLY**

- A. Grounding shall be in accordance with the NEC, as shown on the drawings, and as hereinafter specified.
- B. Underground or inaccessible bonding connections, as well as all connections with or interconnections between grounding electrode conductors, including rebar used as a grounding electrode, shall be made by an approved exothermic welding process. All materials used in an exothermic process shall be by the same manufacturer, and the manufacturer's requirements for preparations of conductors and materials shall be strictly followed.

### **3.02 EQUIPMENT AND CIRCUITS**

- A. Conduit Systems:
  - 1. Line voltage conduit systems, metallic and non-metallic, shall contain a grounding conductor.
  - 2. Conduit provided for mechanical protection and containing only a grounding conductor shall be bonded to that conductor at the entrance and exit from the conduit.
  - 3. Conduit that runs to or from boxes, cabinets or enclosures having concentric knockouts which have not been removed at the conduit connection, shall be provided with bonding jumpers sized in accordance with NEC Table 250.122, and connected with a grounding type bushing / locknut on the conduit and a ground bus or stud inside the box.
- B. Cable Tray: (not Used)
- C. Feeders and Branch Circuits: Install insulated green grounding conductors with all feeders and branch circuits as follows:
  - 1. Feeders serving equipment.
  - 2. Receptacles and lighting fixtures.
  - 3. All items of equipment where the final connection is made with flexible metal conduit shall have a grounding wire.
  - 4. All additional locations and systems as shown on the drawings and as required by the code.
- D. Boxes, Cabinets, Enclosures and Panelboards:
  - 1. Bond the grounding wires to each pull box, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass.
  - 2. Provide lugs in each box and enclosure for ground wire termination.
  - 3. Provide ground bars in panelboards, bolted or welded to the housing (no self tapping or self drilling sheet metal type screws allowed), with sufficient lugs for terminating the ground wires. Bond to neutral where panelboard main serves as building disconnect.
- E. Motors and Starters: Provide lugs in motor terminal box and starter housing for ground wire termination.

- F. Lighting Fixtures: Shall not be grounded through the conduit systems. Fixtures connected with flexible conduit shall have a ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box. The grounding conductor shall be attached to the fixture housing, not the wiring access cover.
- G. Electrical Appliances and Equipment: Fixed electrical appliances and equipment shall have a ground lug installed for termination of the ground conductor.

**END OF SECTION**

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## **SECTION 16500**

### **EXTERIOR LIGHTING**

#### **PART 1 - GENERAL**

##### **1.01 SECTION INCLUDES:**

- A. Exterior luminaires with lamps and drivers.
- B. Luminaire supports.

##### **1.02 REFERENCED SECTIONS**

- A. Section 16050 – Electrical Materials and Methods
- B. Section 16450 – Grounding and Bonding for Electrical Systems

##### **1.03 COORDINATION REQUIREMENTS**

- A. Coordinate the installation of all light fixtures with the work of other trades. This includes but is not limited to placement of fixtures in conjunction with civil work such as sidewalks, roadways, parking lots, landscaping and building exteriors.
- B. Coordinate the installation of all light fixtures with required external surge protection devices. See Paragraphs 2.05 and 2.08 below for more on surge protection requirements.

##### **1.04 SUBMITTALS**

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
  - 1. Submit manufacturer's product datasheet on each and every lighting fixture.
  - 2. Furnish shop drawing portfolios (collated & bound sets) containing the following information:
    - a. Name of manufacturer, make and model of each particular fixture in the project.
    - b. Product listing information (UL, ETL, DLC, Dark Sky, etc...)
    - c. Descriptive cut sheets Indicate fixture catalog number selections, highlight or make obvious which part numbers are used to build the complete fixture catalog number.
    - d. Complete photometric information and coefficient of utilization tables.
    - e. Fixture voltage, match to project specifics.
    - f. Wiring diagrams for power, control, and signal wiring.
    - g. Photoelectric relays and how they interconnect into the system schematically.
    - h. The number, type and wattage of the fixture lamps. Include lamp rated life, color temperature, color rendering index (CRI), initial & mean lumen output.
    - i. The wattage and illumination information for LED fixtures. Include rated life, color temperature, CRI, initial & mean lumen output of LED fixtures.

- j. Lens information including type, pattern, thickness, material type, special features.
  - k. Fixture options, mounting details and ceiling compatibility information.
  - l. Construction of fixture housing and door, door type, access hole information.
  - m. Fixture ballast and driver manufacturer and type information.
  - n. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- 3. All lighting fixtures required to be used on this project shall be submitted in one single submittal so that all fixtures can be reviewed at one time. Those fixtures not receiving a shop drawing action of "Reviewed" or "Reviewed and Noted" on the first submittal shall be resubmitted for review. A light fixture receiving a shop drawing action of "Resubmit" or "Rejected" after the third review for any reason, shall be furnished as originally specified.
  - 4. The portfolios shall be made from standard manufacturer's specification sheets. Each fixture shall be identified by the letter or number indicated on the fixture schedule or project plan sheets as applicable. The combining of more than one fixture type of fixture on a single sheet shall not be acceptable.
- B. Shop Drawings for nonstandard or custom lighting fixtures: Show details indicating dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast and driver, dimmer-controlled fixtures, provided by manufacturer.
  - C. Product Schedule: For all luminaires and lamps, using the same designations as on the Project Drawings.
  - D. Qualification Data: For testing laboratory providing photometric data for luminaires.
  - E. Product Certificates: For each luminaire type and for each photoelectric relay type.
  - F. Product Test Reports: For each luminaire, for tests performed by a qualified testing agency. Provide all applicable source quality-control reports.
  - G. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
  - H. Provide all applicable field quality-control reports.
  - I. Project Record Documents: Record actual connections and locations of luminaires and any associated remote mounted components. Provide this information along with project 'as-builts' per the contract documents plans and specifications.
  - J. Warranty: Provide a copy of the sample warranty prior to commencement of work. Include a copy of the final approved warranty in the project close out documentation.

#### 1.05 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

- D. Manufacturers: Firms regularly engaged in the manufacture of interior and exterior light fixtures of types and ratings required, whose products have been in satisfactory use in similar service for not less than three (3) years.
- E. Installer: Qualified with at least three (3) years of successful installation experience on projects with interior and exterior lighting fixture work similar to that required for this project.
- F. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- G. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- H. Provide luminaires from a single manufacturer for each luminaire type.

#### 1.06 REFERENCES

- A. NEC Compliance: Comply with the NEC (NFPA 70) as applicable to the installation and construction of lighting fixtures.
- B. NEMA Compliance: Comply with applicable requirements of NEMA Standard Pub. Nos. LE-1 and LE-2 pertaining to lighting equipment.
- C. ANSI/UL Compliance: Comply with ANSI/UL Standards pertaining to interior and exterior lighting fixtures for hazardous locations. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements.
- D. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits.
- E. IESNA LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; Illuminating Engineering Society.
- F. IESNA LM-80 - Approved Method: Measuring Lumen Maintenance of LED Light Sources.
- G. NECA 1 - Good Workmanship in Electrical Construction, latest edition.
- H. NECA/IESNA 501 – Standard for Installing Exterior Lighting Systems, latest edition.
- I. Underwriter's Laboratories (UL) Listings. Provide fixtures that have been UL Listed and labeled to any or all of the following standards as applicable to the project:
  - 1. UL 844 - Luminaires for Use in Hazardous (Classified) Locations.
  - 2. UL 924 - Emergency Lighting and Power Equipment.
  - 3. UL 1598 - Luminaires.
  - 4. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

#### 1.07 DELIVERY, STORAGE AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 501 (exterior lighting), NECA/IESNA 502 (industrial lighting), and all manufacturer's written instructions.

- B. Keep fixtures in original product packaging until ready for installation. Do not leave unpackaged fixtures unattended or where they are subject to dirt, debris, or damage.
- C. All fixtures shall be kept warm, dry, safe and secure. Adhere to manufacturer storage requirements.
- D. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

#### 1.08 WARRANTY

- A. Provide a five (5) year manufacturer warranty for all exterior fixtures, LED drivers, and LED light boards (light engines) from date of substantial completion of the project. This warranty to cover all product defects, performance criteria, and parts.
- B. Manufacturer and installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures, including luminaire support components.
    - b. Faulty operation of luminaires and accessories.
    - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

### PART 2 - PRODUCTS

#### 2.01 FIXTURES, GENERAL

- A. All fixtures shall be UL or other qualified third party listed for the environment where they will be installed including: damp, wet, extreme temperature, or hazardous locations.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- D. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
  - 1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
- E. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- F. Metal Parts: Free of burrs and sharp corners and edges.
- G. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- H. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- I. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally.



during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

- J. Exposed Hardware Material: Stainless steel.
- K. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- L. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- M. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
- N. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- O. Luminaire Finish:
  - 1. Manufacturer's standard paint applied to factory-assembled and factory-tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- P. Variations in Luminaire Finishes:
  - 1. Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved samples and are assembled or installed to minimize contrast.
- Q. Diffusers and Globes:
  - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
  - 3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
- R. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USES ONLY" and include specific lamp type.
    - b. Lamp diameter, shape, size, wattage and coating.
    - c. CCT and CRI for all luminaires.
- S. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant to withstand common vibrations encountered at installation site.
  - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

## 2.02 MANUFACTURERS

- A. Manufacturers: As noted on the drawings by notes and/or by the light fixture schedule dictated by this Section. Subject to compliance with requirements, provide products by one of the following:

- 1. Clarifier Walkway Lighting: Lithonia RADPT Series

## 2.03 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with general requirements found in the UNL Design Guidelines. Comply with all manufacturers written instructions for the physical characteristics and installation procedures.

## 2.04 LED LIGHTING FIXTURES

- A. Complete LED lighting fixtures for general illumination shall have been tested by IES LM-79 and LM-80 requirements.
- B. LED light fixtures shall be fabricated, assembled, and manufactured as a complete fixture unit, including housing, mounting hardware, driver, light boards (light engines), and lens.
- C. LED lighting fixtures shall allow for separate replacement of the light boards and driver. In other words, 'throw away' fixtures with non-replaceable components are not permitted.
- D. LED lighting fixtures shall be capable of continuous dimming as a standard offering. Dimming range to be from 100% to at least 20% of rated lumen output. Dimming control shall be 0-10VDC.
- E. All LED fixture control devices shall be compatible with the type of drivers and dimming requirements of the particular project and coordinated with the lighting fixture submittals prior to ordering.
- F. Universal input voltage (120-277 VAC) drivers shall be provided for all LED applications.
- G. In-line fusing: On the primary for each luminaire.

## 2.05 LED DRIVERS

- A. Drivers shall operate from a 60Hz input AC voltage from 120V-277V. Unit shall have an input voltage tolerance range of at least +/- 10%.
- B. The Total Harmonic Distortion (THD) of the driver input current shall be no more than 20% when operating at nominal input voltage.
- C. Drivers shall have a minimum Power Factor (PF) of 0.90.
- D. Drivers shall comply with IEEE/ANSI C62.41 Category C2 (medium) for transient voltage protection. This shall include a 10kV rating, and 5kA rating per the standard 8x20us combo wave testing parameters.
- E. Drivers shall comply with the requirements of the FCC rules and regulations, Title 47 CFR Part 18, Non-consumer (Class A) for EMI & EMF (conducted and radiated) interference.
- F. Fixtures may require additional surge protection apart from what is integral with the LED driver. See Paragraph 2.08 below for more details.

## 2.06 LED BOARDS

- A. Rated minimum life of 60,000 hours minimum per IES LM-70 testing requirements.
- B. Provide a TM21 report on LED boards to be used which tests LED life and lumen maintenance per the IES LM-80 standard, and LED light output and efficacy per the IES LM-70 standard.
- C. The correlated color temperature (CCT) of the LEDs shall be 4000K unless noted otherwise. The CCT shall be uniform for all LED modules within like luminaire types and luminaires within a given project. The LED CCT measurements shall have a maximum of three standard deviations (3 SDCM, +/-90K) tolerance on the MacAdam Ellipse.
- D. Provide LED boards such that any individual LED failure on a section of LED board within the fixture will not result in significant output loss of the overall fixture.

## 2.07 EXTERNAL LED DRIVER SURGE PROTECTION DEVICE (SPD)

- A. All pole mounted LED light fixtures, and pole mounted outdoor sports lighting LED products shall come equipped with an additional layer of SPD protection. This additional protection shall be in addition to requirements of the surge protection integral to the LED driver itself.
- B. The SPD shall be circuited immediately upstream of the LED driver and mounted either within the fixture or immediately adjacent to it in a concealed, protected, and accessible location. Do not void manufacturer warranty or listing requirements when mounting the SPD.
- C. The external SPD shall be circuited either in series or parallel with the light fixture circuit as required of the project and Owner needs. In series circuiting shall de-energize the fixture upon SPD failure (indicating a problem) while parallel circuiting shall allow for continued fixture use after SPD failure.
- D. The additional SPD shall have a kilo-amp rating in excess of the kilo-amp rating of the fixture it is protecting. Minimum specifications shall meet IEEE/ANSI Category C2 (medium) 10kV, 5kA @ 8/20us standard combo and 6kV, 100kHz ring wave protection.
- E. The additional SPD shall have a let-through voltage rating or Voltage Performance Rating (VPR) that limits the voltage to the downstream driver to within the voltage tolerance of the driver. Anticipated maximum clamping voltage (8/20us @ 10kA) as follows: 600V (120V circuit), 1000V (208-240V circuit), 1500V (277V circuit), and 2500V (480V circuit).

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 TEMPORARY LIGHTING

- A. If approved by the Engineer, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

### 3.03 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports. Additional support requirements include:
  - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
  - 2. Sized and rated for luminaire weight.
  - 3. Able to maintain luminaire position after cleaning and relamping.
  - 4. Support luminaires without causing deflection of finished surface.
  - 5. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- C. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- D. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Drawings.
- E. Coordinate layout and installation of luminaires with other construction.
- F. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- G. Comply with requirements in Section and Section 16450.

### 3.04 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 16050 Electrical Materials and Methods. In concrete foundations, wrap conduit with 0.020-inch thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.05 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.

### 3.06 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections:
  - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
  - 2. Verify operation of photoelectric controls.

- C. Illumination Tests:
  - 1. Operational Test:
    - a. After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass test(s) and inspections.
- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.07 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

### 3.08 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
  - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
  - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  - 3. Adjust the aim of luminaires in the presence of the Architect and UNL Project Manager.

## **END OF SECTION**

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